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1908.

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PROCEEDINGS  
OF THE  
GENERAL MEETINGS FOR SCIENTIFIC BUSINESS  
OF THE  
ZOOLOGICAL SOCIETY OF LONDON.  
(January to April, 1908.)

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January 14, 1908.

Prof. J. ROSE BRADFORD, F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions made to the Society's Menagerie during the month of December 1907 :—

The number of registered additions to the Society's Menagerie during the month of December was 175. Of these 89 were acquired by presentation and 4 by purchase, 50 were received on deposit, 1 by exchange, and 31 were bred in the Gardens. The number of departures during the same period, by death and removals, was 174.

Amongst the additions special attention may be directed to :—

One Hainan Gibbon (*Hylobates hainanus*), ♂, from Hainan, presented by R. Douglas, Esq., on December 6th.

One Grévy's Zebra (*Equus grevyi*), ♂, from Abyssinia, received in exchange on December 9th.

One Ethiopian Aard Vark (*Orycteropus aethiopicus*) from Naivasha, British East Africa, presented by the Marquess Gandolfi Hornyold on December 17th.

One Macqueen's Bustard (*Houbara macqueeni*), caught in the Red Sea, presented by Mr. Jos. Vyskocel on December 9th.

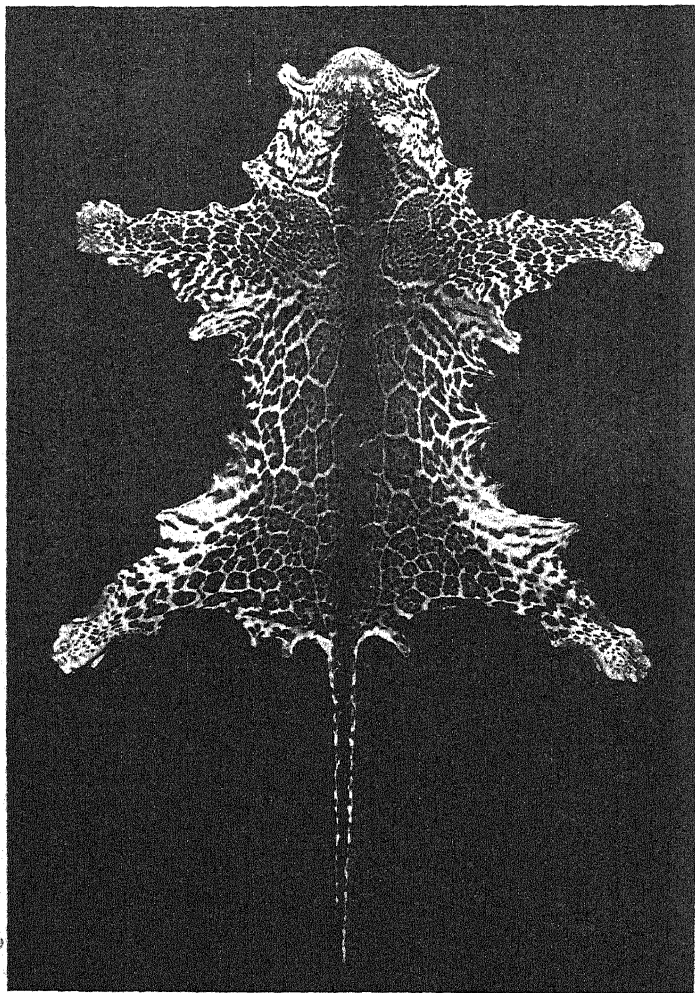
Two Royal Pythons (*Python regius*) and one Nose-horned Puff-Adder (*Bitis nasicornis*), from S. Nigeria, presented by R. B. Brooks, Esq., on December 20th.

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On behalf of Mr. Lydekker, an abnormally marked Leopard-skin from the Deccan, India, was exhibited by Mr. Pycraft. The specimen would shortly be presented to the British Museum by

Mr. F. A. Coleridge, who shot the animal from which it was taken near Putnam, Cuddapah, in December 1906. The following

Text-fig. 1.



Abnormally marked Leopard-skin from the Deccan.

notes on the specimen (of which a photograph is here given) were supplied by Mr. Lydekker:—

According to information supplied by the donor, leopards of the ordinary type abound in the district where the abnormally

marked specimen was killed. In the pattern of the markings this skin appears to be altogether unique. The most striking feature is a kind of network of broad yellow lines commencing on the head in a large, somewhat diamond-shaped area and continued all down the back in meshes of smaller size. Within each mesh is a large black-bordered patch, containing a central area darker than the big network, upon which is a variable number of black spots. In many instances the borders of the patches are incomplete. The other details of the pattern are sufficiently apparent in the photograph. Beyond referring to the fact that the markings, so far as they resemble those of any normally coloured animal, make a slight, although decided, approximation to the Jaguar-type, I am unable to offer any explanation of the remarkable style of ornamentation presented by this extremely handsome skin.

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The following papers were read :—

1. Description of a Biological Expedition to the Birket-el-Qurun, Fayûm Province of Egypt. By W. A. CUNNINGTON, B.A., Ph.D., F.Z.S.

[Received January 14, 1908.]

An expedition was undertaken by me in conjunction with Mr. C. L. Boulenger, to investigate the flora and fauna of the Birket-el-Qurun, a lake in the Fayûm province of Egypt—the Lake Moeris of the ancients. The expedition left London in the middle of March 1907, and eight weeks were spent in collecting on the shores of the lake. Since the railway comes within some seven miles, there were no difficulties of transport to contend with, the journeying about the lake being accomplished in a sailing-boat of moderate size.

The Birket-el-Qurun, or lake of the horns, is still of considerable dimensions, being about 25 miles long, and having a maximum breadth of 5 or 6 miles. It is, however, only a remnant of the historic Lake Moeris, which was many times greater, and was used as an artificial regulator of the Nile floods by the monarchs of the XIIth dynasty. The lake still communicates with the Nile by means of the Bahr Yusef, a channel over 200 miles long, which diverges from the river a short distance north of Assiut. The inflow and outflow of water was originally controlled by means of lock-gates, but since these were allowed to fall into disuse, more and more of the extremely fertile land was reclaimed, until the lake was reduced to its modern dimensions. It is believed that the surface of the lake was at one time some 70 feet above the level of the Mediterranean; at the present day, it is approximately 140 feet below sea-level.

In addition to the historical evidence, there are not wanting

signs of a considerable reduction in size, for raised beaches are in many places very apparent, and the lake has become extremely shallow, the greatest depth being between four and five fathoms. Additional evidence is afforded by the nature of the water, which is sufficiently brackish to be quite unpalatable. The density is slightly above that of fresh-water, and the proportion of soluble salts about one-fourth that in the ocean.

The almost complete absence of seiche alterations of water-level is probably due to the shallowness of the lake, as are also the rather striking figures obtained of the water temperature. A maximum of  $94.2^{\circ}$  was observed in very shallow water close to shore about 2.0 p.m., whilst a minimum of  $54.8^{\circ}$  was obtained as a surface reading in the early morning. The difference between the surface temperature and that of the water below may also be very great, one reading showing the water at three fathoms to be  $12.4^{\circ}$  colder than that at the surface, whilst a difference of  $8.8^{\circ}$  was detected in water only one fathom below.

The lake would seem to be remarkable more for the quantity of life which its waters contain, than for the number of different species inhabiting it. From the greenish water, the tow-net collects immense swarms of Entomostraca—principally Copepoda and Cladocera—as well as large numbers of Rotifera. The only phyto-plankton, however, which is present in the tow-nettings, consists of two or three species of Diatoms.

The fish collected by the expedition were obtained for the most part from the native fishermen, who secure large quantities from the well-stocked waters. The fishing industry is highly organised and the bulk of the catch is despatched to the Cairo market. Fifteen species of fish were secured, belonging to seven families. All of these are well-known Nile forms, but more than half of them are recorded for the first time from the Birket-el-Qurun. The so-called Nile perch (*Lates niloticus*) is stated to attain a large size in the lake, a specimen which measured 120 cm. and weighed 54 lbs. being considered by the local people as by no means extreme. Although 15 species are thus known to inhabit the waters of the lake, two of them occur in such remarkable abundance as to make the others appear rare. These are *Tilapia galilea* and *Tilapia nilotica*, the latter being the more abundant. The fish markets very frequently contain nothing but these two species, which are caught with casting nets in the swampy shallows, or with seines in the deeper water.

In addition to Copepods and Cladocera from the open lake, Ostracods are found on the muddy bottom and in the swamps, while certain Oniscidæ were collected on the beach. It is rather singular that no other Crustaceans were obtained: no crabs or prawns were procured, although they are well-known in the Nile, neither were any Argulidæ observed on the large numbers of fish examined. In the swampy pools on the lake margin were found water-beetles of apparently little interest, Hydrachnids of the genus *Eulais*, and certain spiders.

From such regions too, and from the lake bottom, come the few species of Mollusca obtained. Only a single Lamellibranch was amongst these. Truly aquatic worms are represented solely by the Oligochaete *Paranais littoralis*, no leeches or Turbellaria being found, although they might well be expected to occur. A Polyzoan is fairly abundant, growing on the submerged stems of plants, or on the underside of rocks and boulders. It is a gymnomatous form, with a circular lophophore and eight tentacles.

*Cordylophora lacustris*, a form often associated with brackish water, grows luxuriantly on stones in shallow water. A much more interesting and quite unexpected discovery was that of a medusa and the hydroid form with which it is associated. The hydroid was obtained first, being dredged from the bottom in about a fathom of water: the medusa made its appearance in the lake in vast quantities at a somewhat later date. It appears to be a typical Anthomedusan, and has some resemblance to the marine genus *Sarsia*. Although the Birket-el-Qurun is now slightly brackish, it certainly was quite fresh within historic times, and it is not easy to suggest how such a characteristically marine organism should have found its way into the lake. It is curious to note that no fresh-water sponge was obtained by the expedition, although *Spongilla* occurs commonly in the Nile.

Algae were collected throughout the lake, being scraped from the rocks and stones and the submerged stems of plants. Of the truly aquatic higher plants, *Potamogeton interruptus* and *Chara vulgaris* are both of some interest, as they show slight differences from the common form.

The expedition was undertaken at the request of Captain Lyons, F.R.S., Director General of the Egyptian Survey Department, which has recently paid a good deal of attention to the study of this lake and the whole Fayum province.

## 2. The Duke of Bedford's Zoological Exploration in Eastern Asia.—VI. List of Mammals from the Shantung Peninsula, N. China. By OLDFIELD THOMAS, F.R.S., F.Z.S.

[Received December 2, 1907.]

In March 1907 our President's collector, Mr. Anderson, landed at Chefoo on the Shantung Peninsula, in order to commence work in Northern China. Nothing has been done in this region since the time of Consul Swinhoe, and good modern specimens of the species he obtained are required before any further progress can be made.

As may be gathered from the following notes by Mr. Anderson, the Peninsula is highly cultivated, and almost treeless, so that it is naturally poor in Mammalian life. He has nevertheless obtained good series of the few mammals found there, and these will be of much use in the further study of Chinese Mammalogy.

*Notes on Shantung.*

"I arrived in Chefoo on March 12th, 1907, and was obliged to stay there until the 26th, when I moved into the country eight miles to the south, to remain until April 10th.

"The Shantung Peninsula consists of a complicated series of mountains isolated from other ranges by the broad plain of the Hoang-ho.

"In the region of Chefoo plains and hills alternate, the former being broad, treeless, and though dry are under cultivation for wheat and millet; the latter rise to a height of 1000 feet or more, are steep, rocky, and barren. In general the only trees that occur are diminutive pines, no taller than a man, which are allowed to grow in some parts of the hills; but occasionally in some favoured or sacred spot, a cemetery, or temple land, one finds pines or oaks of larger size. It was such a place that I found eight miles south of Chefoo. Here the steep and rocky hills bore a sparse wood of oak, which flourished under the protection of a Buddhist Temple.

"On April 13th I began work at Ai-san, a mountain about 30 miles west of Chefoo; here I remained till May 1st. Ai-san is an isolated granite crag, 3200 ft. high. Its foothills, in which I took up quarters at an altitude of 1200 ft., are of granite and dry granitic sand, clothed in spots with the usual diminutive pines, and cut by precipitous canyons through which numerous streamlets flow from the mountain. Were it not for this frequency of water the hills would I think be untillable even to the Chinese, but the valleys, canyon bottoms, and sometimes the hillsides are cultivated up to 1200 ft."—*M. P. A.*

1. *ERINACEUS DEALBATUS* Swinh.

♂. 1461. ♀. 1447. Chefoo.

Originally described from Peking.

"Purchased alive from peasants who had brought them into Chefoo. Said to be not uncommon, but I failed to find them myself. Seems to be strictly nocturnal."—*M. P. A.*

2. *MUS CONFUCIANUS SACER*, subsp. n.

♂. 1385, 1387, 1388, 1393, 1394, 1397, 1398, 1399, 1401, 1402, 1403, 1405, 1406. ♀. 1386, 1389, 1390, 1391, 1395, 1396, 1400, 1407, 1408, 1409, 1410, 1411, 1412. Near Chefoo. 300'.

♂. 1424, 1430, 1434, 1440. ♀. 1423, 1431, 1432, 1433, 1443, 1445. Ai-san, 30 miles W. of Chefoo. 1200'.

A female in spirit (No. 1404), with 2—2=8 mammae.

A buffy-grey subspecies of *M. confucianus*; tail long-haired, white-tipped.

Size about as in true *confucianus*. Fur soft, not spinous in specimens killed up to 25th April, and probably never so, as the members of this group are not known to change seasonally in this respect, as is the case in *Apodemus speciosus*. General colour above greyish-buffy or clay-colour, darkened by longer black hairs

on the back, clearer buffy on the sides, a buff line edging the white of the belly. Under surface pure sharply-defined white throughout. Ears grey-brown, finely edged with white. Upper surface of hands and feet pure white, the metapodials not darkened. Tail long, very well haired, so that the scales are nearly hidden, the terminal pencil of hairs 5 to 7 mm. in length; its colour brown proximally above, its under surface and its terminal third (occasionally half) white all round, though some shorter hairs on the end of the tail above are also sometimes dark.

Skull as in Fokien specimens referred to *M. confucianus*, but the teeth uniformly larger.

Dimensions of four specimens:—

	Head & body. mm.	Tail. mm.	Hind foot. mm.	Ear. mm.
♂ .....	156	186	31	21
♂ (Type) ...	144	172	29	20.5
♀ .....	141	177	28	21
♀ .....	130	170	29	20.5

Skull of type—greatest length 38 mm.; basilar length 30; greatest breadth 17.2; palatilar length 16.5; palatal foramina 7.1; length of upper molar series 6.

*Type.* Adult male B.M. No. 8.2.8.8. Original number 1398. Collected 30th March, 1907.

This fine series of specimens is remarkably uniform, there being practically no variation in any important respect. None of the specimens have any trace of the darker markings on the metapodials found in true *M. confucianus*, nor is there any material variation in the degree of whiteness of the tail. Bonhote's *Mus huang* and *M. ling* are both much more fulvous in colour, while neither they nor *confucianus* have the tail so heavily pencilled as it is in *M. c. sacer*.

The belly of these rats would appear to be more yellow in life than it is in skin, judging from the name given them by Mr. Anderson.

"Sulphur-bellied Rat.—Common among the rocks in the temple-woods near Chefoo, rarely met with elsewhere. In the sacred woods it feeds mostly on acorns, leaving large accumulations of the shells in cavities beneath the rocks."—*M. P. A.*

### 3. *APODEMUS*\* *AGRARIUS* *PALLIDIOR*, subsp. n.

- ♂. 1365, 1417, 1419. ♀. 1420. Near Chefoo. 300'.  
 ♂. 1422, 1425, 1426, 1428, 1429, 1435, 1436, 1437, 1446.  
 ♀. 1427, 1439. Ai-san. 30 miles W. of Chefoo. 1200'.  
 ♂. 1453, 1460. ♀. 1448. Near Wei-hai-wei. 300'.

On laying out the whole of the fine series of the *A. agrarius* group obtained by Mr. Anderson in the East, there proves to be a

\* Kaup, Entw. Gesch. Nat. Syst. Eur. Thierw. p. 154 (1829).

Type *A. agrarius* (*Mus agrarius* Linn.) antedates *Micromys* Dehne, 1841.



certain amount of geographical variation, although this is obscured by the individual variation in size and the development of the dorsal stripe already referred to in previous papers of the present series.

The following synopsis indicates the local races into which the eastern forms of *A. agrarius* appear to be divisible:—

A. (Northern.)

- a. Colour dark—more or less tawny. Belly hairs washed with pale tawny. Dorsal streak well developed.

Mantchuria. *A. a. mantchuricus* Thos.

- b. Colour less rich—approximating to “cinnamon.” Belly hairs white-tipped. Dorsal streak variable.

Korea and Quelpart. *A. a. coreæ*, subsp. n.

B. (Southern.)

- c. Colour comparatively greyish—approaching wood-brown, the head and fore quarters lighter than the back. Dorsal streak always present ..... Shantung Peninsula. *A. a. pallidior*, subsp. n.

- d. Colour more uniform and brownish. Dorsal streak usually obsolete ..... Nanking to N.W. Fokien. *A. a. ningpoensis* Swinh.

The two forms now given new names may be briefly described as follows:—

APODEMUS AGRARIUS COREÆ.

Summer pelage more or less spiny. General colour above approximating to “cinnamon” of Ridgway, not so ruddy as in *mantchuricus*, more so than in *pallidior*. Belly hairs grey basally, white terminally, not washed with tawny or buffy. Dorsal streak variable, but never of the clear well-defined unspotted black throughout usually characteristic of true *agrarius*.

Dimensions of four specimens from the typical locality:—

	Head & body.	Tail.	Hind foot.	Ear.
	mm.	mm.	mm.	mm.
♂ .....	91	81	21	13·5
♀ (Type) ...	110	95	20·5	13
♀ .....	103	81	21	14
♀ .....	95	80	21	13·5

Skull (of type)—greatest length 27·5 mm.; basilar length 22; length of upper molar series 3·8.

*Hab.* Korea and Quelpart. Type from Min-gyong, 110 miles S.E. of Seoul. 1000'.

*Type.* Adult female. B.M. No. 6.12.6.74. Original number 654. Collected 24th Nov. 1905.

The two series of this form obtained by Mr. Anderson are enumerated in the papers on the Korean collections.

APODEMUS AGRARIUS PALLIDIOR.

Size perhaps averaging rather less than in the more northern forms. Fur not spiny, but no specimens seen dated later than May 10. General colour above paler and more greyish-white than in the allied forms, especially on the head and across the

fore-quarters; this pallor appears to be due to the hairs being light, almost whitish subterminally, their extreme tips being of the usual reddish-brown tone. Belly hairs white-tipped. Dorsal streak fairly uniform throughout the series examined, very slightly marked and often obsolete anteriorly, fairly well-defined posteriorly; never so strong as in *agrarius*, *manchuricus*, and the more strongly marked specimens of *corea*, but on the other hand much more evident than in *ningpoensis*, which usually has almost no trace of a stripe.

Dimensions of four specimens:—

	Head & body. mm.	Tail. mm.	Hind foot. mm.	Ear. mm.
♂ (Type) ...	93	100	19	13
♂ .....	89	82	20	13
♀ .....	97	83	20	11
♀ .....	82	77	20.5	13

Skull of type—greatest length 27.5 mm.; basilar length 22.5; length of upper molar series 4.1.

*Hab.* Shantung Peninsula. Type from near Chefoo. 300'.

*Type.* Old male. B.M. No. 8.2.8.29. Original number 1419. Collected 5th April, 1907.

This subspecies is no doubt most nearly allied to "*Mus ningpoensis*" Swinh.\* (*M. harti* Thos.), which I should now consider as a subspecies of the *Apodemus agrarius* group. It differs, however, both by its paler colour and by the uniform presence of a dorsal stripe, this being but rarely perceptible in the more southern animal.

"Caught usually in traps set under rocks near water-courses. At Ai-san their ears were nearly always diseased, and I think thereby shortened."—*M. P. A.*

#### 4. *CRICETULUS TRITON* de Wint.

♂. 1415, 1416, 1418. ♀. 1366. Chefoo, Shantung. 100'.

♂. 1454. ♀. 1450, 1451. Wei-hai-wei. 300–400'.

These welcome examples, practically topotypes, of the hitherto little-known *C. triton* vary unexpectedly in size among themselves, but none of them equal in tooth-length, and only one very old specimen in hind-foot-length, the immature type of *C. nestor*, discovered by Mr. Anderson in Korea. Their tails also show an unusual amount of variation in length.

A specimen referable to *C. triton* has recently been presented to the Museum by Mr. E. B. Howell, who trapped it at Tientsin, thus carrying its known range to the west of the valley of the Hoang-ho.

Curiously enough, both Mr. Anderson and Mr. Howell note a predilection on the part of these animals to make their burrows in human grave-mounds, on the south side of which they sink a perpendicular hole.

\* P. Z. S. 1870, p. 637; cf. Bonhote, P. Z. S. 1905, ii. p. 397.

5. *CRICETULUS GRISEUS* M.-Edw.

♂. 1355, 1360, 1361, 1362, 1363, 1367, 1368, 1372, 1373, 1374, 1376. ♀. 1356, 1358, 1359, 1364, 1369, 1370, 1371, 1375, 1377, 1381. Chefoo. Sea-level.

♂. 1442. ♀. 1438, 1441. Ai-san, 30 miles W. of Chefoo. 1200'.

♂. 1452, 1458. Near Wei-hai-wei. 300'.

This fine series is very uniform in general colour and in the development of the dorsal line, which is as distinct in the young ones as in the adult. The following are the flesh-measurements of four of the largest examples:—

	Head & body.	Tail.	Hind foot.	Ear.
	mm.	mm.	mm.	mm.
♂ .....	100	27	15·5	15
♂ .....	97	28	16	15
♀ .....	91	28	15·5	16
♀ .....	86	29	15·5	16

Mr. Howell also obtained this species at Tientsin, and there were two examples in the collection from N. Shantung presented by Mr. Styan and worked out by de Winton. The latter used for them the name of *C. obscurus*, but *griseus* comes first in Milne-Edwards's book, and even if the two are different, which is most doubtful, *griseus* should, for geographical reasons, be the name for the little hamster of Shantung.

"Although not common this was almost the only mammal in the fields about Chefoo. Its burrows were most often in small banks in the gardens, but sometimes occurred between the rows in wheat fields."—*M. P. A.*

6. *LEPUS SWINHOEI* Thos.

*Lepus tolai* Swinh. P. Z. S. 1870, pp. 449, 450.

♂. 1382, 1383, 1384, 1392, 1421.

♀. 1357, 1379, 1380, 1414. Chefoo. 300'.

♂. 1444 (young). Ai-san, W. of Chefoo. 1200'.

♂. 1455-7 (young), 1459. ♀. 1449. Near Wei-hai-wei. 300'.

These specimens are all of the paler type of coloration described by Swinhoe as characterising his third (♀) specimen, though they vary among themselves in this respect.

"Common near Chefoo and near Wei-hai-wei, but rare near Ai-san (where there are wolves). Where common this hare is conspicuous, for although the body is much the colour of the soil, the white tail is an advertisement. It is not wild, but will stop again and again if one whistles sharply. This hare has a voice of some strength, as wounded ones showed by crying out plaintively, or sometimes threateningly, as I approached. I found the flesh very palatable, and many are killed for the Chefoo market."—*M. P. A.*

3. On the Musculature and other Points in the Anatomy of the Engystomatid Frog, *Breviceps verrucosus*. By FRANK E. BEDDARD, M.A., F.R.S.

[Received December 11, 1907.]

(Text-figures 2-13.)

I have examined or dissected three examples of a species of *Breviceps*, which I refer to the species "*verrucosus*" on the following grounds. In the definition of the Frog by Boulenger\* the body is stated to be "entirely covered with distinctly porous granular glands." This was the case with my specimens, which therefore appear to differ from *Breviceps gibbosus*. Inasmuch as our knowledge of this African and ant-eating Batrachian seems to be confined to its external and osteological characters, I have thought it worth while to bring before the Society a further contribution to the knowledge of its structure. The notes upon which the present communication is founded chiefly relate to those structures which are known to vary in their characters among the Anurous Amphibia. Other characters, however, are not altogether ignored.

§ *Pelvis and Coccyx.*

It is of course well known † that *Breviceps* is distinguished from (e. g.) *Rana* by the widely expanded transverse processes of the sacral vertebra and by the fusion of that vertebra with the ensuing coccyx. Since the latter point at any rate has been found, though rarely, to vary among the Anura, it is perhaps worth while to record here the fact that I found in two specimens a complete fusion between the sacrum and the coccyx. When the frog is extended with the dorsal surface uppermost, the ilia are not visible as they are in *Rana* to a great extent, and the ilio-coccygeal muscles descend on a plane which only forms a small angle with the plane of a sagittal section. The strongly expanded transverse processes of the sacral vertebra show no connection with the ilia when viewed from above. These bones are quite invisible if the dorsal surface of the transverse process has been cleaned and the underlying musculature left alone. The attachment of the ilia, in fact, is not to the edge of the broad transverse process as in some other Batrachians, but is completely ventral leaving the edge entirely free.

Another structure in connection with the pelvis of *Breviceps* remains to be described, which I have not noticed, or seen a description of, in other Frogs. On the dorsal surface of each sacral transverse process, lying, apparently, freely on that process, is a flat and somewhat oval plate of cartilage not so long as the transverse process is in an antero-posterior direction. This plate

\* Cat. Batr. Sal. 1882, pp. 176, 177.

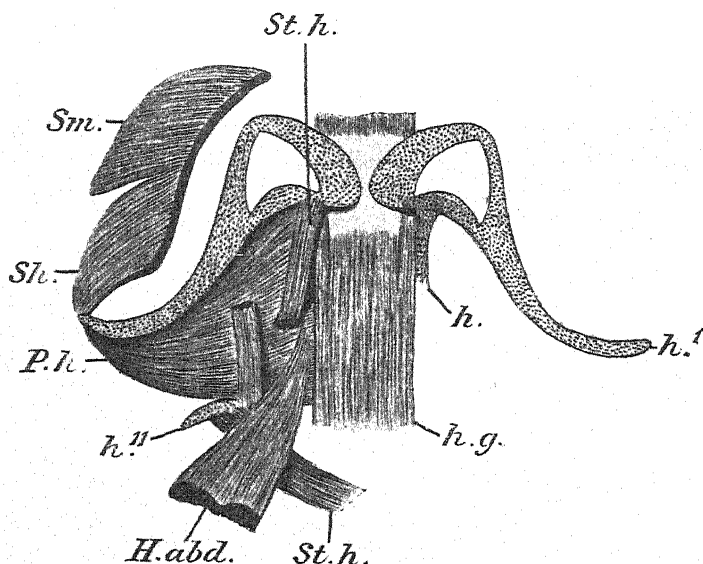
† "Amphibia" in Broun's Thierreich, pp. 608 & 640.

therefore lies completely on the expanded sacral transverse process. Anteriorly fibres of the—as I presume—ilio-lumbaris muscles are inserted upon the cartilaginous plate, and quite anteriorly it is connected, though feebly, round the edge of the transverse process, with the expanded end of the ilium. I imagine that this cartilage belongs to the ilium, and that it is in consequence related to it as the suprascapula is to the scapula. We have, in fact, in this frog an exaggeration of the grooving which the anterior end of the ilium of other forms shows at its line of articulation with the sacral vertebra. It is, moreover, interesting to observe that we find in this frog a kind of foreshadowing of the relations which the ilia bear to the sacrum in the higher Sauropsida—especially birds—where the ilia are not merely attached to, but cover, the sacral vertebrae.

### § Hyoid.

This cartilaginous complex presents some peculiarities of form in *Breviceps*. Of these the most salient are shown in the accompanying figure (text-fig. 2) illustrating also some of the hyoid

Text-fig. 2.



Anterior cornua of hyoid and part of hyoidean musculature of *Breviceps*.

*h.* Basihyal plate. *h*<sup>1</sup>. Anterior cornu of hyoid. *h*<sup>11</sup>. Lateral process of basihyal. *H.abd.* Hyoabdominal muscle. *h.g.* Hyoglossus. *P.h.* Petrohyoideus. *Sh.* Subhyoideus. *Sm.* Submaxillaris. *St.h.* Two divisions of sternohyoideus.

muscles. It will be there seen that the anterior cornua of the hyoid are particularly stout and strong which is correlated,

perhaps, with the unusually strongly developed subhyoides muscle. Again, correlated with these facts of structure is the mode of origin of the anterior cornua from the body of the hyoid. As the text-figure referred to shows, the anterior cornu on each side bifurcates near to its junction with the body of the hyoid, and shortly afterwards the two branches rejoin, thus forming an almost triangular foramen. Anteriorly there is no distinction between the cornu itself and the anterior process of the body of the hyoid, such as is so marked in *Rana*. In fact, the connection of the anterior cornua of the hyoid with the basihyal recalls the arrangement of the corresponding cartilages in the not nearly allied *Pelodytes*, but more so as there is a close approach in the middle line between the rounded-off ends of the conjoined anterior process and anterior cornu of either side; they do not, however, so nearly meet in *Breviceps* as is the case with *Pelodytes*.

The figures of the hyoid apparatus of other Frogs given by W. K. Parker\* show no types which closely resemble *Breviceps* in these particulars. In many forms, however, there is no anterior process on either side of the basihyal, and in others there is an approximation between the anterior lateral process of the basihyal on each side and the corresponding cornu. The thyrohyals of *Breviceps* are also peculiar in certain respects. Each is ossified as usual and is of the customary hourglass-shape, being—that is to say—thinner in the middle than at its two ends. It is, moreover, rather bent in the middle outwardly. The end by which it articulates with the body of the hyoid is not affixed to that cartilage as in many (? most) Frogs. In the latter the bone is inserted on to the posterior edge of the basihyal cartilage. In *Breviceps* it is quite distinctly inserted on to the ventral surface of the cartilage in front of the posterior edge †.

### § The Musculature of the Hyoid.

As might be expected from the habits of the Frog, the Hyoid muscles differ in many respects from those of *Rana*, &c. I shall describe under the heading of the abdominal muscles an important muscle which I term *hyoabdominal*, which is a part of the superficial abdominal sheath inserted on to the hyoid.

The *sternohyoid* is also a peculiar muscle. For it is composed of two perfectly distinct parts. The anteriorly attached part has the usual insertion on to the body of the hyoid ventrally between the (posteriorly) diverging halves of the geniohyoideus of its side. This part of the sternohyoideus arises almost entirely from the coracoid dorsally; the second half of the sternohyoideus is in contact at its origin with the last, and appears also to be continuous with such fibres of the very feeble rectus abdominis

\* Phil. Trans. pt. i. 1881.

† Parker's figure of *Engystoma carolinensis* suggests that this is also the case with that species, which is of the same family.

sternalis as reach the sternum. Its direction is from the very first different from that of the anterior portion of the muscle. It passes downwards at a greater angle with the plane of the coracoid and to the inside of the hyoabdominal, dorsally to which it then passes to be inserted opposite to the insertion of the outer part of the geniohyoid. The hyoabdominal thus passes between the two portions of the sternohyoid, and it is able to insinuate itself into the narrow space prepared for its reception, not by a diminution of its fibres or a lessening of its diameter by becoming converted into a tendon, but by bending over so that its broad and flat surface comes to be disposed perpendicularly instead of horizontally.

The *geniohyoideus* of *Breviceps* appears to offer no very great differences from the same muscle in *Rana*. But the two inner halves of the two muscles fuse together some way back over the subjacent hyoglossus more markedly than in *Rana*, and in this the muscle recalls the geniohyoid of the Pelobatidæ\*.

I could find no trace whatever of an *omohyoid* muscle.

The *hyoglossus* completely envelops each thyrohyal. The fibres run aggregated into coarse strands over the body of the hyoid. In the region of the thyrohyal the hyoglossus is overlain by a thin layer of muscle which appears to be perfectly continuous with the geniohyoid (see text-fig. 7, A, p. 28), that is of course with the inner division of that muscle. The fibres, however, are here transversely arranged to the longitudinal axis of the thyrohyal and are wrapped round the enormously thick hyoglossus. In view of their direction these fibres can hardly be referred to the geniohyoid and called by its name; but they appear to be clearly a differentiation of the same sheet of muscle. The function of this sheet of muscle appears to me to be possibly this: the enormously developed musculature—the hyoglossal—which enwraps each ceratohyal tends to occlude, particularly during its contraction, the glottis, and thus to hinder free respiration. This would, however, be advantageous during swallowing. During relaxation of the hyoglossal the diameter of that muscle would, perhaps, be still further reduced by the contraction of the transverse sheet, and the orifice into the lungs in consequence enlarged.

The *petrohyoid* muscles are present in the normal number and are thick and fleshy leaving no gaps, and indeed overlapping each other. The posterior division of the muscle seems to be less attached to the thyrohyal than is usual among these Batrachians.

The *petrohyoideus posterior primus* has apparently some connection with the bony thyrohyal bar. When the latter is raised, the muscle is seen to underlie it (it is of course dorsal to the bone) and to be posteriorly attached to it. The muscle is, in fact, anteriorly inserted on to the edge of the body of the hyoid behind the posterior lateral process, this portion of the body of the hyoid being, as already explained, overlain by the thyrohyal

\* See P. Z. S. 1907, p. 895.

which does not arise from its edge. When this first section of the petrohyoideus posterior is raised, it is seen to overlies the posterior portion of the petrohyoideus anterior, which latter therefore is a more extensive muscle than is usual among the Batrachia Salientia.

The *petrohyoideus posterior secundus* is attached in the present species as is the petrohyoideus posterior tertius of some other Frogs. It is inserted, in fact, on to the expanded lower extremity of the thyrohyal bone. Whether some fibres escape to be connected with the laryngeal apparatus I do not know.

The *petrohyoideus posterior tertius* is quite different in its relations from the corresponding muscle in other Frogs whose anatomy is known. In order to see the muscle the secundus has to be raised. When this is done, the muscle now under discussion is seen as a somewhat slender muscle running parallel with the other parts of the petrohyoideus posterior. But it has no relations whatever to the thyrohyal bone. This in itself is a point of likeness to the Pelobatidæ. But the resemblance ceases with this. For in *Breviceps* the muscle avoiding altogether the end of the thyrohyal ends in close juxtaposition to the œsophageal muscle on the walls of the commencement of the lung (see text-fig. 7, B). Its action on contraction would appear from its position to be like that of the œsophageal muscle and would dilate the pulmonary cavity.

#### § *Superficial Muscles of the Ventral Surface.*

The general appearance of these various muscles, after the skin has been removed, is very different from the corresponding view of the musculature of *Rana*. I shall proceed to describe these several muscles, commencing with the rectus abdominis and passing forward to the throat. All the muscles now in question are shown in the accompanying figure (text-fig. 3). As is well known, the thighs of this frog are included within the area of the body, the portion of the leg from the knee onwards alone projecting beyond the contour of the trunk. But when the skin was reflected and turned back, it was to be observed that the area lying between the anterior border of the thigh and the posterior border of the abdomen is not merely covered by skin. For closely adherent to the skin in this region, and indeed inserted upon it, is a layer of muscle (to be considered in greater detail later, p. 26) attached on the other side to the leg which bridges over the gap. The conditions are not, therefore, very widely different from those which characterise *Xenopus*\* and *Pipa*†, where muscles attached to the leg spread into the abdominal region and thus help to destroy the demarcation between thigh and abdomen.

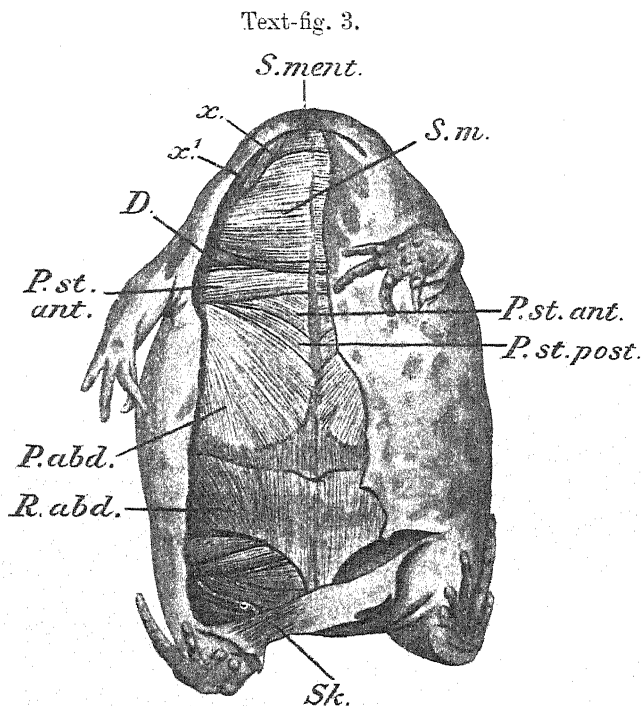
The *rectus abdominis* muscle appears to me to have in pro-

\* Beddard, "On the Diaphragm &c. of *Xenopus*," P. Z. S. 1895, p. 844, fig. 3.

† *Id.* "On . . . the Anatomy of *Pipa*," *ibid.* p. 838, fig. 4.



portion to the animal a very great thickness where it arises posteriorly by the usual two fleshy pillars, one for each half of the muscle. It is sharply crescentic in outline on each side, a state of affairs which appears to have been brought about by the inclusion of the thigh within the body and the consequent and mutual pressure. This is plainly shown in the figure (text-fig. 3) and is to be contrasted with the relative form of the same muscle in *Rana*. The rectus abdominis of *Breviceps* also differs



Superficial ventral musculature of *Breviceps*.

*D.* Clavicular head of deltoid. *P.abd.* Pectoralis abdominalis. *P.st.ant.* Pectoralis sternalis anterior. *P.st.post.* Pectoralis sternalis posterior. *R.abd.* Rectus abdominis. *Sk.* Skin-muscle of thigh. *S.m.* Submaxillaris and subhyoidens hardly distinguishable for some way after their origin. *S.ment.* Submental. *x.*, *x¹.* Muscles of jaw (not specially studied).

from that muscle in *Rana* by the fact that there is only one *inscriptio tendinea* instead of the four or five of *Rana* and of many other Frogs. This one tendinous inscription is placed a little way behind the origin of the abdominal portion of the pectoralis muscle which overlaps it nowhere. It is hidden anteriorly by the complete union across the middle line of some of the fibres of the abdominal pectoral

The *pectoralis* muscle comes next in order and consists of the usual three parts. The *portio sternalis anterior* is very much larger than the *portio sternalis posterior*, and is at its origin in the middle line nearly three times the diameter of the latter. It is incompletely divided into two portions. There is no gap between the two parts of the *portio sternalis*, nor between the posterior of these and the *portio abdominalis*; nevertheless the several muscles are not in any way confused at their origins; they are perfectly distinct. The *portio abdominalis* is large and important. It allows no trace to be seen of any scapular portion of the *obliquus externus* such as is figured in Ecker's work upon the Frog. It arises mainly from the surface of the *rectus abdominis* in front of the single tendinous inscription of the latter. There is also an origin not represented in *Rana* (or represented indeed by the posterior part of the *portio sternalis* of that Amphibian) from the expanded cartilaginous sternum. The fibres of the two sides of the body here meet in the middle line of the sternum. This region of the *portio abdominalis* is not, however, separated in any way from the rest of the muscle; its fibres lie side by side with those of the rest of the muscle and there is no gap anywhere. Indeed, on both sides of the body the sternal fibres of the *portio abdominalis* actually overlap the hinder edge of the *portio sternalis posterior*, that part of the latter muscle in fact which arises from the rhomboidal cartilaginous sternum; for the latter muscle arises more from the edge of the sternum, while the fibres of the *portio abdominalis* arise from the ventral surface of the same cartilage. There being no omosternum in *Breviceps*, there is no superficially visible equivalent of the *sternoradialis* of *Rana*. The only thoracic muscle visible in front of the *pectoralis* is the clavicular head of the *deltoid*, which is shown in the figure referred to (text-fig. 3, D).

The throat-muscles visible on the superficial view are again different from those seen in *Rana* without any further dissection than the removal of the skin. As in *Rana*, a large sheet of muscle occupies the throat which obviously consists, as in that Frog, of the *submaxillaris* and *subhyoideus* muscles. The two halves of each of these are separated along the median line by a very narrow tendinous raphe. But whereas in *Rana* by far the greater part of this sheet belongs to the *submaxillaris*, only a slender slip posteriorly being referable to the *subhyoideus*, the precise reverse is the case with *Breviceps*. In fact in the Frog which forms the subject of the present memoir, the diameter (antero-posterior) of the *submaxillaris* is 2.5 mm., and of the *subhyoideus* is 5.5 mm., the measurements being taken near to the middle line. This is accounted for of course by the reduced lower jaw of *Breviceps*; but not entirely so, since fibres of the muscle, which, did they continue in a straight course, would reach the ramus of the lower jaw, bend posteriorly to form part of the mass of the *subhyoideus*. It should be stated in explanation of the above, that medianly there is no differentiation of the two

muscles: it is only when they diverge a little to the inside of the mandible that they can be distinguished. In front of this lies the *submental* which has quite normal relations. In addition to these three muscles of the throat which are quite as recognisable in *Rana*, *Breviceps* possesses another small muscle which is not visible in a corresponding dissection of *Rana*. This is seen on one side on the right (text-fig. 3, *x*), running along the inside of the jaw as a fairly broad slip of muscle passing out of sight just behind the submentalis. Between the subhyoideus and the wall of the skull and the articulation of the mandible, there is a considerable space left which is not occupied by muscle. It is filled with a loose tissue which I have not investigated farther. In it, however, lies a large circular flattened and somewhat muffin-shaped body which I take to be the thymus gland, on account of its general (though not minute) agreement in position with the thymus of *Rana*.

#### § Muscles of Shoulder-girdle\*.

The *latissimus dorsi* is not a large muscle, and it is entirely hidden for the whole of its course by the muscular origin of the *obliqui externus et internus*. And these latter muscles are too thick to allow of the *latissimus dorsi* being seen through them; they have to be dissected away to bring that muscle into view. Not only is the *latissimus dorsi* a small muscle relatively speaking, but it extends for a much shorter way backwards than in *Rana*, owing perhaps and partly to the very forward position and the small size of the suprascapula. The *latissimus dorsi* does not at all overlap the *infraspinatus*.

The *cucullaris* does not cover the occipital region of the *longissimus dorsi* as is the case with *Rana guppyi*; nor has it so straight a course from the occiput to the border of the suprascapula. Furthermore it skirts the curved dorsal border of the suprascapula to be inserted into the posterior angle of that cartilage.

The *retrahens scapulae* belongs in this Anuran to the *serratus* (or *transverso-scapularis*) series, that is to say it arises from transverse process and not from spinous process. It is necessary to emphasise this point because I have shown that in *Rana guppyi* this muscle does so arise, and we may therefore fairly speak of it as a *rhomboideus*. I take this opportunity of confirming that fact on the results of the dissection of another individual. But whether *Breviceps* can be said to possess this muscle is a matter open to dispute. In *Rana (guppyi)* as well as *esculenta* there are three muscles which have been termed *serrati*, but which in Haslam's edition of Ecker (made use of by myself in the preparation of the present communication) are described as *transverso-scapularis*. Of these muscles two are broad and flat

\* The *pectoralis* as well as the *omoabdominal* are described under the ventral musculature on p. 22.

and pass directly upwards, or very nearly so, from the region of the transverse process of the vertebra to the under surface of the suprascapula. They really arise from the transverse process. The third muscle (text-fig. 7, A, *t.sc.*, p. 28) is long and slender, arising from the tip of a transverse process and inserted lower down on the scapula. In *Breviceps* the slender third muscle (*transverso-scapulae tertius*) is plain; but there are only two of the broad dorsally running portions, and one of these has been already referred to as the *retrahens scapulae*. Moreover these muscles seem to me to arise from the surface of the *longissimus*, and not from transverse processes.

*Coraco-humeralis*.—When the posterior part of the portio sternalis and the portio abdominalis of the pectoralis are cut through and reflected, two muscles are brought into view without any further dissection and when the Frog is lying upon its back. These are of unequal size, the smaller of the two lying nearest to the coraco-humeral margin. I am disposed to regard this muscle as corresponding to that which I have termed "*pectoralis minor*" in *Pipa* and in *Rana guppyi*. It arises mainly from the coracoid, but some of its fibres appear to reach the sternum. It is inserted on the humerus to the posterior side of the insertion of the pectoralis abdominalis, *i. e.*, below that muscle as seen in the position of dissection referred to. The larger muscle I term therefore *coraco-humeralis*, which arises from the same bone and cartilage as the last. Towards its insertion it is a much larger muscle than the last described, and its insertion is farther down the humerus, *i. e.*, nearer to the hand. Both muscles are fleshy throughout.

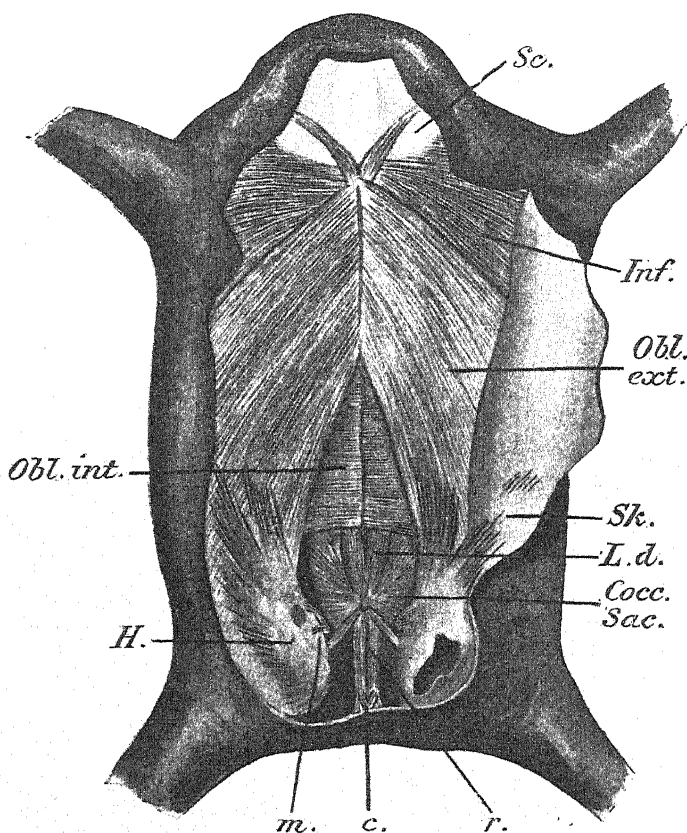
### § Muscles of the Dorsal Surface.

In *Rana* the muscles of the back are covered by, and also in some cases arise from, the fascia dorsalis which is attached in the middle line to the spinous processes of the vertebrae. In *Rana guppyi*, where on account of the size of the frog this fascia is specially thick, it has not obviously any more relations to the depressor mandibulae than to the latissimus dorsi or the obliquus externus, all of which arise from it and are in perfect continuity with it. It cannot be spoken of as the tendon of origin of any one or indeed of all of these muscles. It is described by Ecker in his 'Monograph of the Frog' in a separate paragraph as something distinct from the ensuing muscles. It is to be assumed, however, that in common with many other tendinous structures this fascia dorsalis is to be referred to a previously existing sheet of muscle. But there is nothing in *Rana* to connect it definitely with any of the muscles which arise from it, excepting perhaps the obliquus externus on account of its larger size. It must be remembered, however, that in *Xenopus (Dactylethra)* the latissimus dorsi is of very large size\*, and in shrinking to the dimensions which it

\* Maurer, "Die ventrale Rumpfmuskulatur der Anuren Amphibien," Morph. JB. 1895; and Beddard, P. Z. S. 1895, p. 846 (and footnote).

shows in *Rana* may have, so to speak, left behind it a tract of tendon—the fascia dorsalis. The condition of the dorsal musculature in *Breviceps* suggests a different explanation. There is no fascia at all in the middle of the back; only anteriorly between and upon a portion of the suprascapulae is a thin transparent sheet of ligament to be detached from the underlying structures.

Text-fig. 4.

Superficial dorsal musculature of *Breviceps*.

- e. Cutaneous muscles at end of rectum. *Cocc.Sac.* Coccygeo-sacralis. *H.* Posterior lymph-heart of left side. On right the corresponding heart is represented as cut open. *Inf.* Infraspinalis. *L.d.* Longissimus dorsi. *m.* Extrinsic muscles of lymph-heart. *Obl.ext.* Obliquus externus. *Obl.int.* Obliquus internus. *r.* Muscles covering rectum. *Sc.* Suprascapula. *Sk.* Skin reflected, showing attachment of extrinsic muscles of lymph-heart.

Posteriorly this is continuous with a sheet of muscle on either side of the body the fibres of which pass obliquely backwards and ventral-

wards and which arise from the middle line of the back, *i. e.* from the spinous processes of the vertebræ. These fibres are continuous with some of those upon the ventral surface which I have shown reasons for believing to be the *obliquus externus* of *Rana*. Immediately beneath them, and equally plainly shown in the drawing (text-fig. 4), is a set of fibres, also arising from the spinous processes of the vertebræ, which run diagonally to the former and are in fact disposed at right angles to the longitudinal axis of the body. These are of course the fibres of the *obliquus internus*. I imagine that these two muscles together in their dorsal region represent the fascia dorsalis of *Rana*. In any case, apart from any question of homologies, it is remarkable to have to note the extreme muscularity of the back of this small burrowing toad when compared with *Rana*. This sheet of muscle completely covers the latissimus dorsi, but it only partly covers the infra-spinatus, the anterior half of which appears, as is shown in the drawing (text-fig. 4), beyond its anterior margin. In this region, in fact, it passes into an aponeurosis. A striking feature of the dorsal musculature of this Frog as compared with *Rana*, is the absence of a *depressor mandibule*. Hence the suprascapula is visible directly the skin is raised. In view of the presumably feeble action of the jaws in this ant-eating toad, the absence of this muscle is not surprising. Posteriorly the obliquus internus ends abruptly at the commencement of the posterior lymph-heart\*. At that point the *longissimus dorsi* emerges from beneath its shelter, and is seen to arise from the coccyx to very far back, in fact within a millimetre of its posterior extremity. This is quite different to what occurs in *Rana*, where the greater part of the coccyx is free from the longissimus dorsi. It may perhaps be argued from this fact, coupled with the fact that the end of the coccyx is a long way from the anus, that *Breviceps* is as compared with *Rana* a short-tailed frog. It also follows that the insertion on to the coccyx of the *ilio-coccygeal* muscle is hidden by the longissimus dorsi.

Since only the extreme tip of the coccyx, represented in the figure to which reference has been made, is free from the attachment of the longissimus dorsi, it is plain that the *coccygeo-sacralis* must be either absent or have rather different relations. In view, however, of the very large transverse processes of the sacral vertebræ in this Batrachian, the muscle would be hardly likely to be absent, and indeed I identify it as shown in the drawing (text-fig. 4, *Cocc.Sac.*). The muscles in question are attached on each side of the body to the strong transverse process of the sacral vertebra. Not, however, to the whole of that process. For the outer part bears the origin of the *gluteus*. The muscle (the *coccygeo-sacralis*) is pyramidal in form; it narrows from its wide origin to the region of the pyriformis, up to which muscle it passes, and is attached at the extremity of the coccyx between the origins

\* For the description of which see p. 33.

of the longissimus dorsi and the pyriformis. This is true of the superficial layer of the muscle. The deeper fibres are inserted upon the coccyx still farther forward, underlying the longissimus, but I have not drawn an exact boundary line between this and the ilio-coccygeal muscle.

When the region of the ilium is inspected from below, the *ilio-lumbaris* muscle is very plainly seen. It arises quite from the tip of the ilium, where it overlaps not as might be expected the coccygeo-iliacus but the glutæus, or rather a portion of it. Owing to the abbreviation of the tail the origin of the coccygeo-iliacus is concealed on this aspect of the body. The ilio-lumbaris (text-fig. 7, A, *Il. l.*, p. 28) is a strong muscle not broken up into segments as in *Rana guppyi*\*, but passing straight forwards to its termination on the transverse process of the third vertebra. It gives off from its concealed (*i. e.* dorsal) surface bundles of muscular fibres to the transverse processes of the intervening vertebra. This muscle, as it appears to me, is in some ways like that of the Pelobatidæ†. For instead of consisting only of detached slips as in *Rana* running from transverse process to transverse process, there is also a massive band of muscle running straight to the most anterior transverse process to which the muscle is attached. This muscle is not, however, separate as in the Pelobatidæ, arising from a lower (more posterior) part of the ilium; it is indistinguishable at its origin from the anterior end of the ilium from the rest of the muscle.

#### § Abdominal Muscles.

The general aspect of the *rectus abdominis* as compared with that of *Rana* has been already described‡, and need not be again here referred to. While in the Common Frog according to various authors the rectus abdominis does not extend far laterally, but is in those regions replaced by the *obliquus externus*, there is in *Breviceps* an absolute continuity between the fibres arising from the pubic symphysis in the two strong pillars already referred to and fibres running in a nearly dorso-ventral direction on the sides of the body (text-fig. 5). They form obviously one sheet which may be stripped off. These fibres extend a long way towards the dorsal median line. More towards the ventral median line, however, they become attached to the tendinous inscription, and with that break are continuous with anteriorly running fibres, some of which end on the sternum. Beyond the tendinous inscription arises, as has been already said, the portio abdominalis of the pectoralis. Beyond this again, *i. e.* nearer the shoulder-girdle, arises a sheet of muscle which is completely hidden by the pectoralis abdominalis. Nevertheless it lies above (ventral to) an underlying sheet of muscle, which latter lies on the same plane as the median region of the rectus abdominis, arising as it does from it or at least from the aponeurosis covering it. This muscle

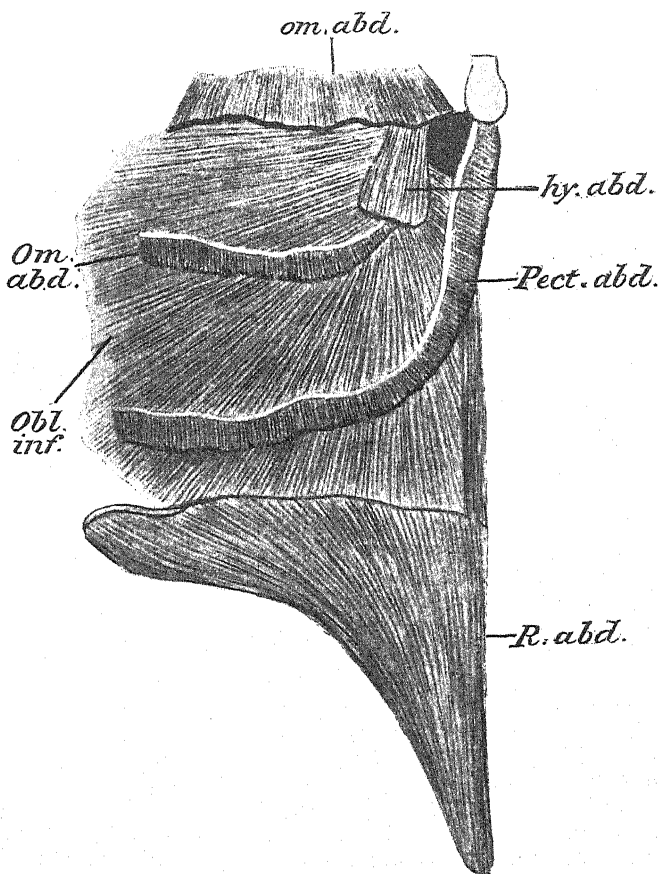
\* Beddard, P. Z. S. 1907, p. 333, text-fig. 94.

† *Id. ibid.* p. 377.

‡ *Supra*, p. 15.

arising from the surface of the deeper layer is very wide, and disappears anteriorly beneath the shoulder-girdle, being inserted dorsally upon the scapula. It would seem to correspond to the portio omo-abdominalis of the obliquus externus of *Rana*, but is clearly much more extensive. The direction of its fibres is on

Text-fig. 5.



Ventral abdominal musculature of *Breviceps* cut so as to display different layers.

*hy.abd.* Hyoabdominal. *Obl.inf.* Obliquus internus. *Om.abd.* Omoabdominal shown below at origin and above near to insertion, the intervening portion having been cut away. *Pect.abd.* Origin of pectoralis abdominalis. *R.abd.* Rectus abdominis.

the whole obliquely postero-anterior. It arises from near the edge of the underlying sheet of muscle also just referred to.



This latter is, as I take it, the *obliquus internus*. In the middle line it can be seen to be covered by the very thin sternal portion of the rectus abdominis. Here its fibres run obliquely forward from the median line, fairly parallel indeed in direction with the fibres of the adjacent and covering pectoralis abdominis. From the inscriptio tendinea the fibres of the obliquus internus run directly forward parallel to the long axis of the body; more laterally they run postero-anteriorly but obliquely towards the median ventral line of the abdomen. Passing round the abdomen the direction of the fibres is gradually changed, until anteriorly just behind the shoulder-girdle the fibres of the obliquus internus run exactly at right angles to the long axis of the animal's body. The obliquus internus, therefore, of *Breviceps* is very different from that of *Rana*, where the fibres run obliquely postero-anteriorly with a main dorso-ventral direction and with but a slight fanning out from the back towards the ventral surface. In *Breviceps* the fanning is much more marked and is in the opposite direction, *i. e.* the fibres converge towards a point upon the ventral surface on each side of the body. This point, or rather area, is formed by the origin of a very strongly marked muscle, flat and of considerable diameter, from the septum between itself and the obliquus internus and running forward parallel with the sternum to be attached to the hyoid. I term this muscle the *hyo-abdominalis*, and I regard it as being, like the omo-abdominalis, a portion of the obliquus externus. Against this view, however, is the fact that it is, in the greater part, covered by the omo-abdominalis. I would further remark that this muscle apparently has its homologue among the Pelobatidæ\*, where, however, it is not quite so important as in *Breviceps* and has a different insertion. I am disposed to regard this peculiar arrangement of the obliquus internus and its relation to a large hyo-abdominalis and the large size of the omo-abdominalis, as being connected with the ant-eating habits of *Breviceps*. The arrangement of the muscles in question is such as to produce a powerful pull upon the hyoid apparatus and tongue. The very slender sternal portion of the rectus is to be associated with the rudimentary and reduced state of the cartilaginous sternum. The large omo-abdominalis is possibly associated with the burrowing habits of the Frog. It would assist in producing a strong pull upon the shoulder-girdle.

The abdominal musculature therefore of this Frog agrees with that of other Anura in the possession of only two layers of muscle. But the exact homology between the variously metamorphosed regions in this and other Anura is clearly difficult to settle. The obliquus internus, as I have termed the inner sheet of muscle, seems to be comparable not only with the obliquus internus of *Rana* but to that muscle *plus* certain parts of the rectus abdominis. For the anteriorly directed fibres of the muscle in

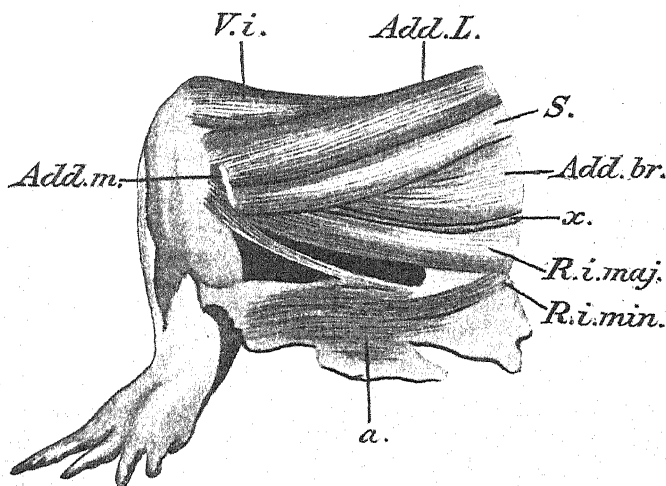
\* Beddard, "On *Megalophrys nasuta*," P. Z. S. 1907, p. 340; *id.*, "On Pelobatidæ," *ibid.* p. 894.

*Breviceps* are obviously part of the same muscle, most of whose fibres have an oblique direction. But elsewhere the rectus abdominis is obviously external to the obliquus internus. It would seem, in fact, impossible to go further than to declare the two layers of the abdominal musculature homologous with the two layers in other Batrachians. An exact homology between individual muscles derived from these layers would seem to be impossible of assertion. It is quite remarkable to note what great differences in the disposition of the fibres in these two layers can exist between closely allied Batrachians, and how plastic these structures prove to be as contrasted with many others whose functions would also seem to be involved with the peculiar mode of life of this frog.

### § *Muscles of the Thigh.*

The muscles visible on the superficial aspect of the thigh are shown incidentally in the figure (text-fig. 3) representing a general view of the musculature of *Breviceps*, and in a more

Text-fig. 6.



Muscles of the inside of the thigh of *Breviceps*.

a. Skin-muscle referred to in text. *Add.br.* Adductor brevis (or magnus?). *Add.L.* Adductor longus. *Add.m.* Insertion on to knee of one of adductors, perhaps comparable to the adductor magnus of other Frogs. *R.i.maj.* Rectus internus major. *R.i.min.* Rectus internus minor. *V.i.* Vastus internus. *a.* A separate adductor slip.

elaborate way in the accompanying figure (text-fig. 6), which represents the thigh-muscles more highly magnified. I take as

usual the corresponding set of muscles in *Rana* for comparison\*, in order to set forth those of *Breviceps*. There is an important difference at the very beginning of this comparison. When the skin covering the thigh is removed or reflected, there is removed or reflected with it a thin sheet of muscle (text-fig. 6, *a*) which, in the middle of the thigh, lies superficial to all the other muscles of the thigh. Its insertion on to the knee is also the most superficial insertion. There seems to be no doubt that this muscle, which underlies the skin over a great part of the thigh, actually arises in part at least from the skin, and is therefore perhaps to be referred to the series of cutaneous muscles which have been described in *Rana*. But there would appear to be no corresponding muscle to this in *Rana guppyi* at any rate. Posteriorly the muscle is not to be distinguished for a great part of its course from the Rectus internus minor. Anteriorly it does not spread on to the abdomen. It seems to have nothing to do with the Rectus abdominis or adjacent muscles. It is purely a thigh-muscle in its position and extent. It is necessary to mention this in view of the peculiar relations of the abdominal muscles to the thigh in *Pipa*. Although, as already said, there is a close contiguity posteriorly with one part of the Rectus internus, its insertion onto the knee seems to be distinct from that of the said Rectus, which muscle will be dealt with presently. Apart from this muscle, which is something superadded, possibly in relation to the inclusion of the thigh within the contour of the body, the general plan of the femoral muscles appears to be not unlike that of *Rana*.

The *sartorius* courses obliquely over the thigh as in *Rana*; its insertion on to the knee is entirely fleshy. It is not a particularly large muscle, being markedly smaller than the neighbouring adductors. Nevertheless, its position and relations seem to fix its correspondence with the *sartorius* of *Rana*, &c. When cut across the muscle is seen to lie in the hollow between its much more massive neighbours. These I take to be the *adductor longus* and (possibly) the *adductor magnus* respectively. In the appearance of the former superficially upon the inside of the knee we have a character not found in *Rana*. This muscle, however, is also inserted on to the inner border of the femur for about the distal third of that bone, and must be, as I imagine, the equivalent of the *adductor longus* of *Rana*. In front of it lies, as should be the case if this homology be true, the *vastus internus*, which is a large muscle.

Between the insertions on to the knee of the two muscles last dealt with a portion of the insertion of another muscle is visible, as clearly shown in the accompanying figure (text-fig. 6, *Add.m.*). This also belongs to the adductor series, and may perhaps be regarded as the *adductor magnus*, the third adductor described above being in that case the *adductor brevis*. The importance of the adductor muscles in this frog is very striking. In a second specimen, the

\* I have figured these muscles in *Rana guppyi* in P. Z. S. 1907, p. 887, text-fig. 234.

insertion of this adductor magnus (if I am right in so terming it) did not appear superficially. This variability, it will be observed, is precisely analogous to that exhibited by the constituents of the triceps femoris on the outside of the thigh, which will be presently described. Returning to the muscles visible on the inside of the thigh, the only ones visible without dissection, in addition to those already treated of, are the *recti interni major et minor*. The connection of the latter with a superficial muscle has already been dealt with. As in *Rana* the semitendinosus does not appear superficially.

On the outside of the thigh the most prevalent muscle is the equivalent of the *triceps femoris* of *Rana*, though its constitution in *Breviceps* differs somewhat. There are, however, three distinct portions which may be termed respectively *rectus femoris*, *vastus externus*, and *vastus internus*. They are, however, all of them inserted separately, instead of by one tendon as in *Rana*. Moreover, the most anterior of the three muscles, the *rectus femoris anticus*, instead of ending in an aponeurosis, is fleshy and thick throughout. The two specimens which I have dissected show a difference in the insertion of the middle of the three divisions of the triceps femoris. In one this goes as far as the knee; in the other individual the muscle is inserted on to the thigh up to about the middle of that bone only. It is therefore not only in the separateness of the three divisions of the triceps femoris, but also in their insertion and complete muscularity that *Breviceps* differs from *Rana*. The *biceps femoris* in *Breviceps* is a particularly slender muscle ending in a long tendon, not flattened, which pushes between the two heads of the gastrocnemius some way after their origins to be inserted a longish way down the fore leg. The *semimembranosus* is of fair size.

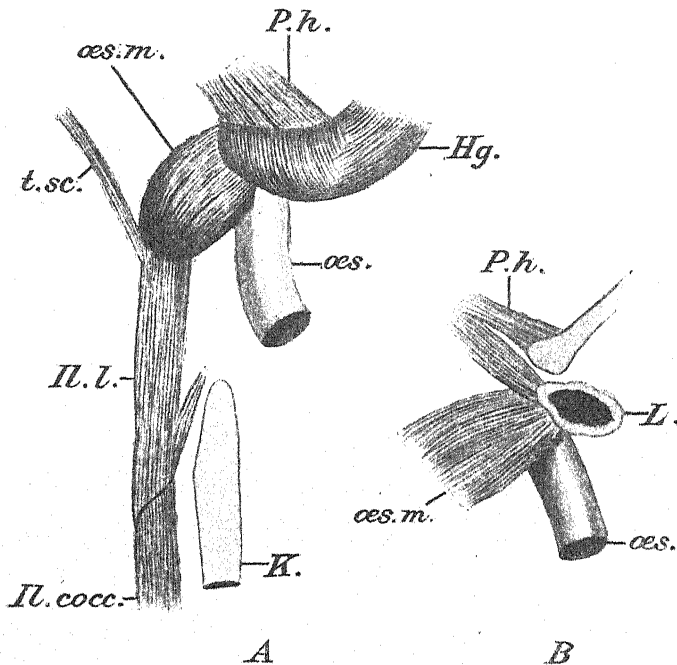
#### § *Œsophageo-pulmonary muscle.*

This muscle in *Breviceps* is a very stout muscle obscurely divided into three or four bundles which have hardly the value of separate muscles. It has no direct connection whatever with the muscles of the wall of the abdomen. It is not (that is to say, obviously) a detached sheet of the obliquus internus, as is the case with the corresponding muscle in all of the Pelobatidæ that have been hitherto examined\*. It is in fact similar in many respects to its homologue in the Ranidæ and Bufonidæ. It arises in them from the transverse process of the fourth vertebra, and this is also the origin of the muscle in *Breviceps*. Its origin lies in front of, and contiguous with, the insertion of the ilio-lumbaris, and to the inside of the origin of the transverso-scapularis. The origin and course of the muscle is shown in the accompanying illustration (text-fig. 7). It nearly meets its fellow of the opposite side of the body in the middle line of the ventral surface of the œsophagus.

\* Beddard, "On Anatomy of a Frog of the genus *Megalophrys*," P. Z. S. 1907, p. 324; and "On Anatomy of Pelobatidæ," *ibid.* p. 386.

A large number of its fibres end upon the œsophagus both laterally and ventrally. In fact the muscle is chiefly an œsophageal muscle, and has less relation with the respiratory apparatus. It is, however, connected with the root of the lung where the walls of this sac, as is shown in the figure referred to, are non-respiratory and thicker, and is undoubtedly attached along the dorsal median line of this region of the lung where it (the lung) forms one cavity with

Text-fig. 7.



Œsophageal and neighbouring muscles of *Breviceps*.

A. These muscles *in situ* without disturbance of adjacent structures, which are, however, not all included in the figure.

B. A further dissection to show relation of œsophageal muscle to root of lung.

*Hg.* Hyoglossus muscle. *Il.cocc.* Ilio-coxigenus. *Il.l.* Ilio-lumbaris. *K.* Kidney. *L.* Lung. *oes.* Œsophagus. *oes.m.* Œsophageal muscle. *P.h.* Petrohyoidens posterior tertius. *t.sc.* Transverso-scapularis.

its fellow. So also of course is the muscle of the opposite side of the body, and the two muscles can be raised here from the surface of the œsophagus by pulling up the common cavity of the two lungs just where it opens into the larynx. The attachment continues on to the cricoid cartilage of the larynx ("annulus" of Wilder\*) which forms in this Batrachian, as in so many others, a

\* Zool. Jahrb., Abth. f. Anat. ix. 1896, pp. 290 &c.

complete bar uninterrupted in the dorsal middle line. None of the fibres of the muscle appear to me to actually run on to the cricoid bar; but their action must result in moving this bar, seeing that it is intimately and strongly connected by their walls with the lungs. Any pull on the roots of the two lungs must tend to raise the cricoid cartilage dorsally.

#### § *Abdominal Viscera.*

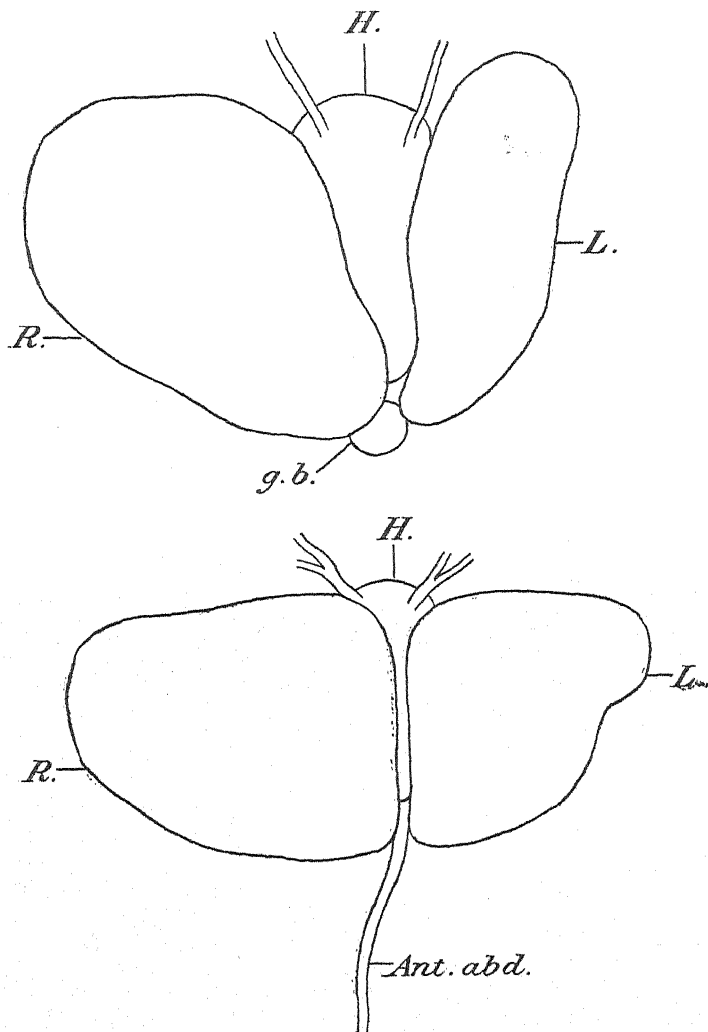
The *Liver* of this Frog (text-fig. 8) is of large size and has the unusual character among the Batrachia Salientia that the right lobe is considerably the larger of the two lobes into which it is divided. Furthermore, the left lobe can hardly be said to be divided into two lobes, as is again so frequently the case with Frogs, though an indentation on its border is an indication of such a subdivision. The liver is, as a whole, very square-shaped. Anteriorly its boundary line is almost straight and is on a level with the posterior border of the coracoid. The two lobes are nearly in contact in the middle line and hardly diverge posteriorly, so that the posterior border of the liver is almost straight. Anteriorly, however, in the middle line they diverge slightly and form a small triangular space; this discovers the heart, which is otherwise quite covered by the liver except for the narrow median ventral slit between the two liver-lobes, where it is apparent. The apex of the ventricle is situated a little way in front of the posterior border of the liver. The smaller left lobe is more triangular in shape than the right lobe. The *gall-bladder* is quite invisible on a superficial view; it lies beneath the inner corner of the right lobe. As far as I can gather from Dr. Günther's account of the Bufonid *Rhinophrynus dorsalis*\*, the liver of this toad bears some likeness to that of *Breviceps*. For he remarks† that the heart of *Rhinophrynus* "is surrounded by the liver in a similar way as in higher animals, as in other Batrachians it is surrounded by the lungs." Furthermore, he observes of the liver that it is divided into a right half and a larger left half. This would seem to be the exact converse of what I note here in *Breviceps*. But elsewhere in the paper Dr. Günther speaks of the stomach being situated "quite on the right hand," which causes me to doubt whether right and left may not be used to express the positions as seen from above during a dissection. Furthermore the liver extends dorsally to the heart, which thus lies in cavities as it were excavated in the liver-substance, and it is almost completely surrounded and hidden by that viscus as in Reptiles and Birds. The likeness between *Rhinophrynus* and *Breviceps* in these features of liver construction are remarkable as possibly related to the ant-eating habit which they have in common, since systematically they are placed in different families. Part of the stomach is concealed by the left lobe of the liver, and the small intestine passes

\* "The Systematic Arrangement of the Tailless Batrachians, &c.," P. Z. S. 1858, p. 339.

† *Loc. cit.* p. 350.

directly anteriorly between the lobes of the liver; most of the coils of the intestine lay entirely above (*i. e.* quite concealed by)

Text-fig. 8.



Ventral surface of liver of two individuals of *Breviceps*.

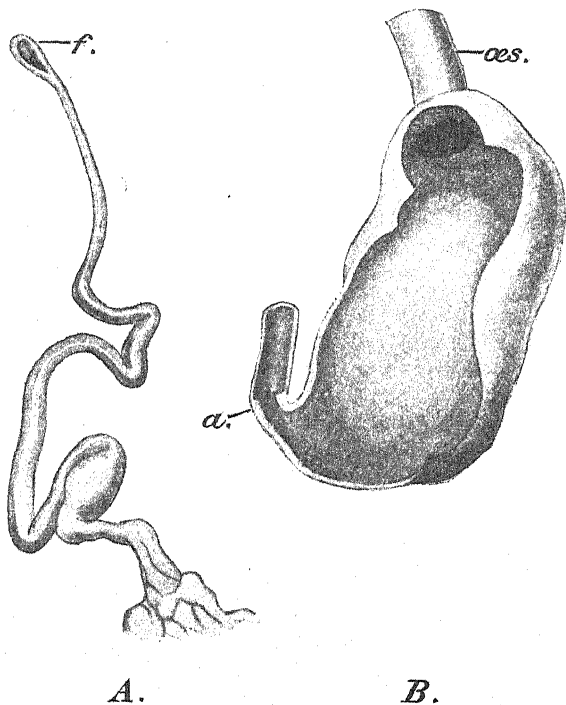
[*Ant.abd.* Anterior abdominal vein. *g.b.* Gall-bladder. *H.* Heart.

*L., R.* Left and right lobes of liver.

the large right lobe. The enormously distended large intestine was entirely uncovered by the liver. The peculiar nature of the

liver and its relations to the heart have been brought about, or at any rate are accompanied, by an alteration in the normal (*i. e.* that found in *Rana*) disposition of the *anterior abdominal vein*. This vein in *Breviceps* gives off no branches to either lobe of the liver until it reaches and has passed some way beyond the apex of the heart.

Text-fig. 9.



A. Part of oviduct. B. Stomach of *Breviceps* (laid open).  
 a. Demarcation between stomach and duodenum. oes. Esophagus.  
 f. Funnel of oviduct.

In a second specimen which I dissected, a male, and which was perhaps in consequence rather smaller than the first, measuring only 33 mm. in total length, the liver showed certain differences. The relative size of the two lobes was the same, but they were not by any means so closely approximated in the middle line as was the case with the larger example. This being so, much more of the heart was visible on a ventral inspection of the viscus, and the conditions more approached that to be seen in the Common Frog. Still, however, there was a considerable difference; for in *Rana* the heart is distinctly ventral of the liver and the lobes extend far beyond it in the direction of the cloaca. In *Breviceps*,

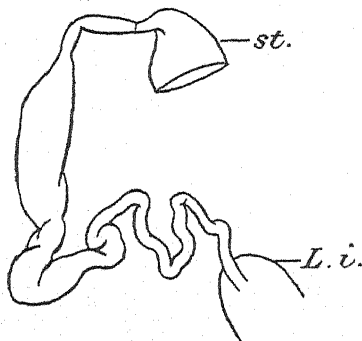


even in this second example to which I am now referring, the liver only just extends beyond the heart and grasps it firmly, as it were, with a lobe on either side. And the pericardium comes into contact and is connected with the absolute ventral edge of the liver-lobe on either side. I could detect no furrowing of either lobe of the liver. The gall-bladder in this, the smaller specimen, instead of being completely hidden, was quite visible for the greater part of its extent between the ends of the two lobes of the liver and extending beyond them even towards the cloaca.

The *Stomach* of this Frog (text-fig. 9) seems to be peculiarly large, and its pyloric projection is sharply marked off from the ensuing duodenum, not only by a constriction but by the fact that the walls of the latter are much thinner than those of the pylorus. The pyloric region of the stomach in fact is quite distinct from the rest of that organ and forms a projection from it; there is no gradual passing of the one into the other as in *Rana*. The stomach itself was swollen and nearer to the spherical than to the ovoid in form. It was full of a mass of ants, among which I distinctly recognised "soldier ants" (with enormous heads) of a species which I have not attempted to identify. The muscularity of the stomach was very evident, and it thus contrasted with the gut. The œsophagus, which suddenly expands into this large stomach, only just enters the abdominal cavity. On cutting open the stomach the smallness, relatively speaking, of the œsophageal aperture into it can be realised.

The *Lungs* float very freely in the cœlom; it is only at the base that they are attached by ligaments. The texture is thin with large alveoli.

Text-fig. 10.



Intestinal canal of *Breviceps*.

st. Stomach. L.i. Colon.

The *Intestine* (text-fig. 10) does not appear to differ greatly from that of *Rana* in its proportionate length. It differs, however, very considerably in certain features of its structure. The first portion

of the small intestine, that immediately following upon the pyloric constriction corresponding to the duodenal loop of *Rana*, is very short, about 5 mm. long (in the smaller male specimen), and directed rather forwards and parallel with the stomach as in *Rana*. It is of narrow calibre, about that of the pyloric process of the stomach. This passes into a middle section of the small intestine, the bore of which is quite twice that of the preceding part, and which forms therefore a very wide tube. This is no case of accidental dilatation, for the same structure was apparent in both examples, and the appearance of the swollen region of the intestine was quite different from the region in front of and behind it. Internally its mucous membrane is raised into transverse folds, which have not the watch-pocket shape of the corresponding folds in the intestine of *Rana*, but are thin wavy folds running right round the lumen. This wider portion of the small intestine passes into a narrow portion again, which is of greater length and of not greater calibre than the beginning of the duodenum. This opens suddenly by a slightly projecting *os* into the very wide but not very short large intestine.

The end of the colon, into the pear-shaped anterior section of which the ileum opens, bulges equally all round the ileum; that is to say, there is no unilateral cæcum. Shortly after the entrance into it of the small intestine the colon diminishes in its width and remains at about the same calibre to the anal apertures. That is to say, of course, the cloaca is no wider than the antecedent colon. The cloaca is of considerable length, and is shown in the figure on p. 20 (text-fig. 4). It occupies the whole of the space lying between the tip of the coccyx and the rather distant end of the body. Being, as it is, in this exposed situation and covered only by the skin, it would appear to be rather susceptible to injury from pressure upon the dorsal surface of the body. It is, however, protected from such injury, it may be supposed, by a thick covering of muscle upon the dorsal surface. This is obviously divided into two longitudinal bands by a furrow, and this arrangement becomes clearer still when the tube is cut across. This muscle arises, partly at least, from the tip of the urostyle and corresponds, I imagine, to the *compressor cloacæ* of *Rana* \*. There are also two very tiny muscular slips attaching the end of the cloaca to the skin just above; they are also shown in the figure referred to.

#### § *Posterior Lymph-hearts.*

These organs are so extraordinarily developed in *Breviceps* that they require a section to themselves for their adequate description. The general topography of their neighbourhood may be first described, as it differs greatly from that of *Rana* and is in relation to the large size of these sacs in *Breviceps*. As already mentioned, the thighs of this species are enclosed within the

\* Ecker's 'Anatomy of the Frog,' Haslam's Translation, p. 348.

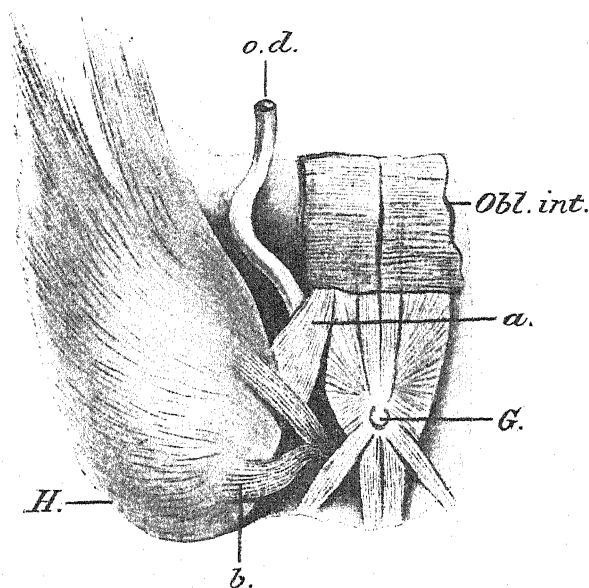
contour of the body which extends for a great distance behind the coccyx. In an example of *Breviceps* measuring 38 mm. from snout to anus the distance from the tip of the coccyx to the anus was quite 7 mm., *i.e.*, more than one-fifth of the total body-length. Furthermore, the breadth of the thighs adds to the large space which intervenes between the posterior edge of the abdominal muscles where they reach the back and the posterior end of the trunk. It is in this large space (see text-fig. 4, p. 20), loosely covered by the skin which does not adhere to the leg until the knee, that the posterior lymph-hearts lie on either side. They do not, however, occupy the whole of this considerable tract. Each, however, is no less than 10 or 11 mm. long in the individual *Breviceps* whose total body-length has been mentioned above. The posterior lymph-heart of *Breviceps* is therefore between one-quarter and one-third of its total body-length. With this may be contrasted the proportions found in *Rana*, where (in *R. temporaria* or *R. esculenta*—very much larger species) the length of the posterior lymph-heart is given in Haslam's 'Translation of Ecker's 'Frog' as "about two lines," *i.e.* 4 or 5 millimetres\*. That is to say, the posterior lymph-hearts of a frog half or one-third of the size of *Rana esculenta* are twice or thrice the bulk of those of that *Rana*. This appears to me to be a very remarkable anatomical fact, and one which argues considerable physiological differences. The posterior end of each lymph-sac was about 4 or 5 mm. from the posterior end of the body. This space was occupied by a lymph-sac corresponding, I presume, to the femoral lymph-sac of *Rana*. It lies at any rate on the thigh-muscles. I found this space on each side filled with a coagulated flocculent mass, probably lymph. This space bears a relation to its corresponding lymph-heart similar to that of an auricle to a ventricle. When the skin of the back is carefully reflected from the middle line, the lymph-heart is at once exposed. No muscles lie between it and the integument. It is, however, slightly attached to the skin here and there by fibres continuous with its own muscular walls. These fibres arranged in slender bundles spread out in a fan-shaped fashion over the skin. They form presumably a fixed point or points to render effective the contractions of the lymph-heart. It may be also that the fibres thus attached belong really to the cutaneous muscular system and correspond in particular to the *cutaneus dorsi* of *Rana*; for other cutaneous muscles are associated with the septa of lymph-sacs. In a general way also these fibres suggest the "*alae cordis*" of Arthropods. In any case the anatomical facts are as has been stated, and are shown in the accompanying figure (text-fig. 11). These fibres as well as the lymph-hearts lie dorsally to and unconnected with the dorsal muscles (which are described on another page †), although the anterior end of the lymph-heart overlaps the end of the dorsal

\* In a large example of *Bufo vulgaris* measuring 115 mm., I found a lymph-heart to be 5 mm.

† *Suprà*, p. 19.

muscles. It is mainly at least by the anterior half or three-quarters of each lymph-heart that it is fixed to the integument by these muscular strands, which have to be cut through in order to free the organ. When it is thus freed it is seen to be of about the same shape as an acorn (without its cup) and divisible into two regions, an anterior and posterior, which are however not very sharply marked off from each other.

Text-fig. 11.

Left lymph-heart of *Breviceps*.

*a, b.* Extrinsic muscles of heart (*H.*). *G.* Tip of coccyx. *obl.int.* Obliquus internus cut off short on both sides. *o.d.* Oviduct.

The anterior part of each lymph-heart (as is shown in text-fig. 12, p. 36), which represents one of these structures completely freed from its attachment to the integument, is of very dense muscular structure, and in consequence quite smooth. The posterior part (not half) of the heart, however, is of a basket-work conformation, strands—varying in breadth, but always broadish—of muscular fibres crossing each other at right angles. The bands of fibres which run in a longitudinal direction are ultimately lost in the regular even and muscular walls of the anterior part of the lymph-heart. The cross-running bands are also seen in the figure to be also gradually differentiated from it. The interspaces between these bands are considerable, and possibly permit of the free entrance

of the lymph into the heart from the lymph-sac already referred to which lies behind it. When a lymph-heart is cut open the structure presented is that which is represented in the lower figure, text-fig. 12. There is the same division into two regions, the walls of the anterior part being smooth and thick. In the posterior part the longitudinally-running bands of muscle stand out from the walls, projecting into the interior of the sac, as is shown in the figure.

Text-fig. 12.



Upper figure, lymph-heart of *Breviceps* isolated ; lower figure, view of interior of same.

The attachment of each lymph-heart to the integument by strands of muscles would doubtless increase the efficiency of that organ as a pump by providing a fixed point for the contraction of its muscles to pull against. There is, however, another series of muscles attached to the opposite side of each heart, and acting in a direction parallel to and in the same plane as, but obviously

opposite to, those integumental sheets. The resemblance of the extrinsic muscles of the heart to the "*ala cordis*" of the Arthropod heart is thus increased, since there is (or at least may be) a pull on each side in opposite directions which would clearly dilate the cavity of the lymph-heart. The contraction of the heart is probably effected by the intrinsic musculature. This muscle, when the heart is viewed from the dorsal surface as in text-fig. 11, is seen to reach the heart as two broad flat bands which fan out over its dorsal surface. They are seen to dip down ventrally between the heart and the ilium, and to unite to form one stout strap-shaped band of muscle. The position of this muscle is exactly on a level with the tip of the coccyx, and there is an exact symmetry between the two of opposite sides of the body. It is inserted on to the symphysis pubis.

In addition to the muscles just mentioned, which are indicated in text-fig. 4 (p. 20), and shown more in detail in a more enlarged representation of this region of the body (text-fig. 11), there is another muscle attached to each lymph-heart more ventrally than that which has just been described. This completes the mooring of the lymph-hearts to the adjacent organs of the body. The muscle now under consideration is single on each side of the body; that is to say, there is one of them to each lymph-heart. It is broad and flat and thin, and shows a metallic glitter on account of its structure; it arises in the neighbourhood of the edge of the expanded transverse process of the sacral vertebra, and thus partly covers over and conceals the coccygeo-sacralis muscle. The course is backwards, and it reaches the first described skeletal muscle of the lymph-heart at right angles to that muscle. It dips under it, and is therefore attached to the lymph-heart rather ventrally. The muscle is broader than that which runs from the pubis to the lymph-heart, but could be readily missed owing to its tenderness and the consequent ease with which it can be torn\*.

### § *Organs of Reproduction.*

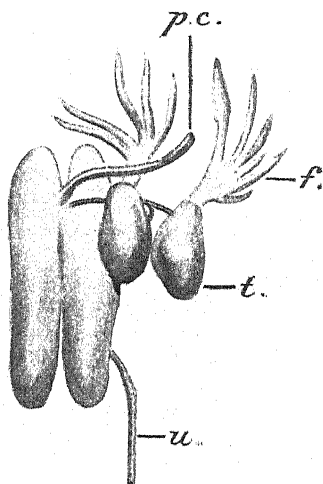
I have had the opportunity of examining both sexes of this frog, as has already been mentioned in relation to the alimentary system. In the male (text-fig. 13), the *testes* have the usual oval form and are not pigmented. From their considerable size, I gather that the individual was sexually mature. They lie very close together and actually indeed in contact, the mesocolon only just being able to push itself between them, as it were. Nor can they be separated by any manipulation short of forcibly tearing them away from the dorsal mesentery which attaches them and the colon to the middle dorsal line. The vasa efferentia seem to offer a new form of these ducts among the Anura. There is only a single

\* The appearance of the lymph-heart is by no means unlike that of the Tortoise as represented by Fritsch, "*Zur Anatomie der Elephant-Schildkröte (Testudo elephantopus)*," Prag 1870, from *Abh. k. böhm. Ges. Wiss.* 1871.

tube arising from each testis, and each of these meets its fellow of the opposite testis and forms with it a single duct; this occurs soon after each has emerged from the testis.

The two *ovaries* are, like the testes, closely apposed in the middle line, and as already mentioned each has a very large fat-body attached to it anteriorly. The eggs were of considerable size (some of them) and, as I should imagine, mature. But the ovaries were not extensive as they are in the mature females of other *Batrachia*. It may be therefore that the oviducts are not as complicated in their coiling as they would have been had the frog lived longer. In this specimen the oviducts were as is represented in text-fig. 9 (p. 32). Anteriorly the funnel is spoon-shaped with an elongated aperture on the lower surface.

Text-fig. 13.



Testes and kidneys of *Brericops*.

*f.* Fat-body. *p.c.* Post-caval vein. *t.* Testes with single vas efferens arising from anterior end of each. *u.* Ureter.

The proximal section of the oviduct is narrow and straight in its course. The thick-walled glandular region of the oviduct only makes two loops, as is shown in the figure referred to. I am inclined to think that the oviduct is after all mature or very nearly so, for its walls are as thick as it seems likely they could become. The glandular part opens into the distal and thin-walled "uterus" which is flattened and strap-shaped. The two tubes approach each other in the same straight line behind the kidneys, and form one tube running of course at right angles to them towards its opening into the cloaca.

### § *Fat-Bodies.*

Although these organs are known to vary among the Anura, from individual to individual, from side to side of the body, and also shrink or become expanded at different times in the life of the individual \*, I think it worth while to describe the appearances seen in the two specimens which I dissected. In both of them the fat-bodies were large and apparently fully developed. In the female they were much the larger; but then the female specimen was considerably larger than the male, a difference which I am disposed to put down as a sexual character. In the female the fat-bodies extended forwards a long way and appeared when the body was opened actually in front of the lungs. In the male they were much smaller and firmly adherent to the front margin of each testis †. Each fat-body was divided distally into five or six finger-like processes of the usual shape.

### § *Renal Organs.*

The kidneys of *Breviceps* are like those of *Rana* in that they are flat smooth bodies with no division into massive lobes such as occurs among the Pelobatidæ. They are represented in text-fig. 13, which shows also the relations of the testes to them. The only peculiarity which they show (so far as I have ascertained) is the complete fusion in the middle line of the right and left viscus in the male. In the female they are very closely apposed but not fused. This fusion is, however, not complete; that is to say, the two organs in the male are not continuous with each other in the middle line throughout the whole of their length. It is only for about one-half of their extent that they are thus fused. Anteriorly the two kidneys are quite distinct until the emergence of the postcaval vein which bends downwards just in front of the point where the two kidneys become almost, if not quite, soldered together. Posteriorly a larger free region is left.

The common duct thus formed does not, as it does in the case of *Discoglossus* and *Alytes*, enter the ureter direct without passing through the kidney. In the present species the duct becomes lost in the substance of the kidney in a way which I did not follow out more minutely. In any case it did not bend round the anterior end of the kidney to join the ureter. The two kidneys are in very close contact below the testes. But the duct showed no signs of division into a branch of each kidney, but appeared to enter the middle line, and was at any rate concealed by kidney-tissue before dividing. As the vasa efferentia referred to were exceedingly obvious on inspection with a lens, I imagine that

\* Boulenger, "The Tailless Batrachia of Europe," Ray Soc. Publication, 1897.

† I may observe that I found no "Bidder's Organ."



others have not been missed. At the same time I cannot of course positively assert that the individual was actually fully mature, though there was no reason against this view.

### § *Resumé*\*.

As compared with *Rana*, *Breviceps* shows the following peculiarities of structure :—

- (1) The rectus abdominis has but one tendinous inscription and its fibres fan out laterally running dorsoventrally, thus replacing a portion of the obliquus externus.
- (2) Part of the obliquus externus is specialised into a strong muscle ending on the hyoid; on to the base of this is inserted the fan-shaped obliquus internus.
- (3) The sternoradialis is absent.
- (4) The subhyoides muscle is twice the diameter of the submaxillaris.
- (5) A special muscle runs from the quadrate cartilage to the inner side of each ramus of the lower jaw.
- (6) The omohyoid is absent.
- (7) The sternohyoid is divided into two perfectly distinct muscles with widely separate insertions into the hyoid.
- (8) The obliquus externus is a purely fleshy muscle arising on either side in the middle line of the back by muscular fibres. There is thus no fascia dorsalis. The obliquus internus is similarly fleshy at its origin from the middle line of the back below the former.
- (9) There is no depressor mandibulae muscle to be detected.
- (10) In the thigh the rectus internus minor is connected with a superficial cutaneous muscle, covering over a portion of the thigh, which is its chief head of origin. The biceps is very slender; the adductors very large.
- (11) The posterior lymph-hearts are of enormous size, measuring more than a quarter of the total length of the body. They are attached by muscles to the skin dorsally and by two separate and broad muscles to the transverse process of the sacral vertebra and the pubis respectively.
- (12) The liver is composed of two lobes only which largely cover the heart.
- (13) The testes emit each only one vas efferens; and the two tubes join before entering the substance of the kidneys (which are here fused) in the middle line.
- (14) The oviducts are very short owing to the fact that they are but little coiled.

\* I do not include in the above *resumé* external and osteological characteristics already well known, nor all minutiae of muscular structure.

- (15) The coccyx is abbreviated and does not extend to the end of the body. To compensate for this the end section of the cloaca which naturally extends beyond it is protected by a pair of strong muscles which are inserted on to the skin above the anus by short slips.
- (16) Upon each sacral transverse process is a detached plate of cartilage which is related to the adjacent musculature, and which perhaps corresponds to the supra-sacral portion of the ilium in Sauropsida.
- (17) The hyoid cartilage is marked by the double origin of the anterior cornua, a foramen therefore occupying the base of each cornu where it joins the body of the hyoid.

The above list contains a brief epitome of nearly all of the points in which I have found *Breviceps* to differ anatomically from *Rana*. In the present state of our knowledge of Batrachian anatomy, it is not possible to use them in order to criticise or confirm any view which has been held with regard to the systematic position of *Breviceps*, except of course to assert that it is in any case not a near ally of *Rana*, or of the family Pelobatidæ\*. Some of its structural features would appear to be associated with its ant-eating proclivities; to this category I would refer the particularly strongly-developed hyoid muscles and the anterior cornua of the hyoid and the round, globular, somewhat gizzard-like stomach sharply marked off from both cesophagus and duodenum. The burrowing habits of *Breviceps* are perhaps to be associated with some other muscular peculiarities; especially, as I should imagine, the extent and muscularity of the two obliqui and of their branches to the shoulder-girdle, and the very powerful muscles of the anterior part of the thigh, and the very thick gastrocnemius. Among the remaining characters of this Frog, those which are particularly noteworthy appear to me to be the following, viz. :—(1) The enormous size and muscularity of the posterior lymph-hearts with their special extrinsic muscles; (2) the presence of a plate of cartilage overlying the sacral transverse process and representing the supra-sacral portion of the ilium in higher types; (3) the nearly complete concealment of the heart ventrally by the liver-lobes; (4) the existence of only one vas efferens for both testes.

\* Beddard, P. Z. S. 1907, p. 324, & p. 871.

4. On the Hermaphroditism of the Amphipod, *Orchestia deshayesii* Audouin. By CHARLES L. BOULENGER, B.A., F.Z.S., King's College, Cambridge.

[Received January 11, 1908.]

(Text-figure 14.)

Otmar Nebeski (1), in 1880, was the first to call attention to the interesting fact that in the male *Orchestia cavimana* Heller (= *O. gammarellus* Boeck), the anterior portion of the testis constantly gives rise to ova instead of spermatozoa.

Della Valle (2), in his Monograph of the Gammarini, partly confirms this statement but remarks that, at least in the species which he examined, *O. deshayesii* Audouin, this phenomenon was neither as common as Nebeski stated nor had he ever seen so large a number of ova as figured by that author. He adds that he has never observed ova in the testes of a fully adult male, but only in a few individuals which, although of large size, yet retained juvenile characteristics in the shape of the posterior gnathopoda.

Geoffrey Smith (3), struck by the discrepancy of the above results, examined specimens of *Orchestia* at Naples during December to March 1905-6. On dissection he found that more than 50 per cent. of the males belonging to both species, whether fully developed or not, exhibited ova in their testes. He therefore came to the conclusion that Della Valle could not have examined *O. deshayesii* during the winter months, and that in the summer, when these animals breed, the fully-developed males lose these ova. As he remarked:—"The males of these species when breeding is not going on assume a semi-hermaphrodite condition of a quite indubitable kind which must evidently bear some relation to the metabolic conditions in the body."

The particular metabolic condition which calls forth the production of these ova is, he thinks, that condition of "adaptive anabolism" which he has studied in the infected males of various animals subjected to "parasitic castration" and in the middle males or males of suppressed sexuality in "high and low dimorphism."

During a recent stay at Naples I undertook this investigation, at the suggestion of Mr. Geoffrey Smith, with the object of ascertaining what evidence could be obtained in support of his results.

The two commonest sandhoppers at Naples are *Orchestia deshayesii* and *Orchestia gammarellus*; although a certain number of individuals belonging to the latter species were examined, most of my observations were made on *O. deshayesii* as being the more suitable form for an investigation of this kind. The chief reasons for this choice were:—

(1) *O. deshayesii* could be obtained in large numbers close to

the Zoological Station; I was thus able to procure a constant supply from one locality at different times of the year.

(2) In this species adult males can without difficulty be distinguished from the young of the same sex by the characters of the second pair of gnathopoda. In the adult male the posterior margin of the "hand" is produced to form a large spine-like process, so that the appendage becomes pseudochelate instead of subchelate as in the female. The young males up to approximately 9 mm. in length possess gnathopoda of the female type; as they increase in size these appendages undergo various modifications, but do not become pseudochelate until maturity (13-15 mm.) is attained.

Barrois (4) was the first to describe and illustrate these stages in the development of the gnathopoda; a similar series is figured by Della Valle in his monograph.

Nebeski has very carefully described the structure of the sexual organs of *Orchestia gammarellus*; I will therefore only briefly summarise the more salient features in the testis of *O. deshayesi*, which agrees in all but details with that organ in the first-mentioned species.

The male generative organs lie on either side of the thorax above the gut and are kept in position by a packing of fatty tissue. The testis itself is of a fusiform shape and extends approximately from the posterior part of the second thoracic segment to the anterior part of the fifth. Anteriorly it is produced into a longish filament which seems to serve as a kind of ligament.

The organ is clothed externally by a layer of epithelial cells with large nuclei; inside is a cavity on the median wall of which the germ-cells are situated arranged in several layers. Posteriorly the testis is directly continuous with the narrow anterior end of the oval vesicula seminalis; in this respect the generative organs of this species differ from those of *Orchestia gammarellus* where, as described by Nebeski, the posterior narrow prolongation of the testis opens into one side of the vesicula seminalis a short distance behind its anterior termination. The vesicula seminalis communicates with a narrow ejaculatory duct which leads to a small chitinous penis situated at the base of the seventh thoracic leg.

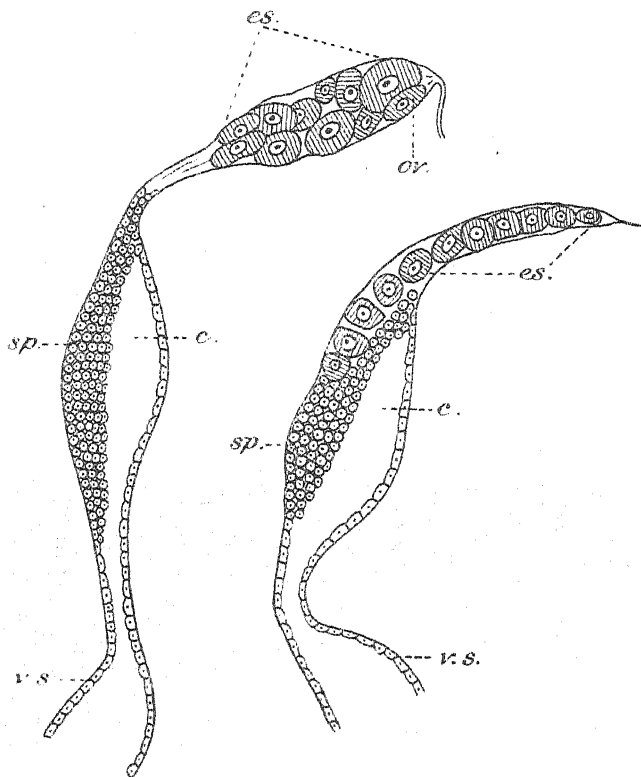
Whilst at Naples I dissected a number of adult males of this species at intervals during the months October to March, and found the testes to be perfectly normal in 135 out of 137 individuals so examined. The two abnormal specimens possessed a few small ova at the anterior end of the testis, just below the origin of the ligament-like filament. Both of these were obtained during the second week of October together with females carrying ova; breeding was therefore still in progress.

A smaller number (47) of large male *Orchestia gammarellus* were also examined by me, but none were found exhibiting any

traces of hermaphroditism. This phenomenon is therefore of very rare occurrence in the adult males.

My experience with immature specimens was however very different, for in these I found that the presence of ova was the rule rather than the exception.

Text-fig. 14.



Testes of two individuals of *Orchestia deshayesi*, to show the position of the ova.  $\times 40$ .

c., cavity of the testis; es., egg-sac; ov., ovum; sp., developing spermatocytes; v.s., vesicula seminalis.

In the smallest males which I was able to dissect (approximately 8-10 mm. in length with scarcely differentiated gnathopoda) the testes had not yet acquired their characteristic fusiform shape, these organs appearing as long narrow bands extending along each side of the thorax. Even at this stage ova had already made their appearance among the germ-cells, and could be easily distinguished from the spermatocytes by their greater size, oval shape, and by

the possession of an enlarged nucleus which hardly stained with carmine or hematoxylin.

Owing to the difficulties of dissection only a few individuals of this age were examined, but all (8) possessed ova of various sizes.

In older specimens, varying in size from 10-13 mm., these ova were found to be of greater size and to occur in greater abundance. Their exact position in the testis varied slightly, but usually the anterior third only was ovigerous.

The ova at this stage have evidently grown at the expense of the surrounding germ-cells, which have disappeared, and come to lie loose in a cavity surrounded merely by the external epithelium of the testis. A kind of egg-sac is thus formed separated by a constriction from the posterior part of the male gland where sperm-production is proceeding with great activity.

In a few specimens, in addition to the ova at the anterior end, others were to be found among the developing spermatocytes in the posterior part of the testis.

The greatest number of ova observed in any testis was 12; this number falls considerably short of that recorded by Nebeski; that author figured as many as 29 in a testis of *Orchestia gammarellus*. Altogether 198 males were examined at this stage, and of these only 19 were devoid of ova.

The fate of these ova I have not been able definitively to ascertain, they have never been seen in the vesiculæ seminales or in the vasa deferentia, and from their position it is highly improbable that they ever reach the exterior. In several testes examined by me the ova were much shrivelled, and it seemed as if they were being resorbed by the rest of the testis.

As the result of this investigation, it seems that ova are of normal occurrence in the generative organs of the young males; later, when these animals attain maturity and acquire their adult characters, these ova in most cases disappear and are probably absorbed by the rest of the organ before the final moult.

These results are therefore much at variance with those obtained by Smith, and I am at a loss to explain how he arrived at his conclusions; I can only suggest that they may be due to his not having sufficiently separated the adult and the young males during the course of his observations.

That ova should be developed chiefly in the testes of immature males of *Orchestia* need cause no surprise, for similar phenomena have been described in numerous animals. This type of "histological" hermaphroditism seems particularly common in Vertebrates, this being probably due to the fact that this group has been more exhaustively studied than any other. A number of cases have, however, been recorded among the Invertebrates:—Ova have been described by Krohn (5) as normally occurring in the testes of *Phalangium*; Garnier (6) has found them in *Astacus*, Ischikawa (7) in *Gebia*, and recently so have Smith (3) and Potts (8) in other Crustacea (*Inachus* and *Eupagurus*) as the result of "parasitic castration."

Among Vertebrates they occur normally at certain periods in the testes of *Petromyzon*, *Salmo*, and numerous amphibians (apart from the problematical "organ of Bidder" in *Bufo*). It is interesting to find that in most of these cases the production of ova is limited to the developing or regenerating testes, and for this reason I will enter on a few more details about such forms.

Thus R. Hertwig (9) has recently given an account of his observations on the sexual organs of young tadpoles. In this paper he practically confirms the theoretical conclusion, first arrived at by Pflüger, that the surplus of females which constantly occurs in broods of tadpoles is due to a more or less developed tendency to hermaphroditism in the males at this stage; some of the so-called females proving to be males at a later stage in their development.

Lubosch (10) has obtained practically the same results from his studies of the sexual organs of the larval *Petromyzon*.

To take yet another example. Felix (11), describing the development of the testis in *Salmo*, calls attention to the "auffallende Thatsache das alle von mir untersuchten jungen Männchen von *Salmo salar* in dem vorderen Abschnitt ihrer Genitaldrüse vollständig ausgebildete Eier zeigen."

It seems then that the phenomenon described by me in *Orchestia deshayesi* is not an unusual one, and finds a parallel in many other animals; its significance and its relation to the various theories formulated to explain such cases of hermaphroditism I cannot discuss here; I will merely refer the reader to the excellent paper on this subject by Stephan (12), in which will be found a lengthy discussion of the current theories bearing upon it.

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P.S.—Since the reading of this paper Dr. Calman has kindly drawn my attention to a paper by Zograf (Zool. Anz. xxx., 1907), in which the author records the occurrence of ova in the testes of *Apus*.

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February 4, 1908.

H.G. THE DUKE OF BEDFORD, K.G., President, in the Chair.

Mr. F. Martin Duncan gave a lantern exhibition of the results he had obtained with the Autochrome Natural Colour Process of the brothers Lumière as applied to zoological subjects.

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The following papers were read:—

1. The Duke of Bedford’s Zoological Exploration in Eastern Asia.—VII. List of Mammals from the Tsu-shima Islands. By OLDFIELD THOMAS, F.R.S., F.Z.S.

[Received December 31, 1907.]

In continuation of his collecting-work in Eastern Asia, Mr. Malcolm Anderson visited the Tsu-shima Islands, between Japan and Korea, at the beginning of this year, and made the collection enumerated below.

The fauna would seem to be comparatively poor, so far as the number of species is concerned, but it is of much interest, owing to the curious mixture of forms which it contains, some of its members being absolutely Japanese in relationship, and others Korean—a mixture the cause of which it is at first sight difficult to guess.

Putting aside the species which, for one reason or another, are



indefinite in relationship, we have the following characteristically Japanese forms :—

<i>Urotrichus talpoides adversus.</i>	No <i>Urotrichus</i> recorded from Korea.
<i>Martes melampus tsuensis.</i>	No Marten of this type known from Korea.
<i>Apodemus speciosus speciosus.</i>	Replaced in Korea by the very different <i>A. s. peninsulae</i> .
„ <i>geisha sagaw.</i>	<i>A. geisha</i> common in Japan, absent from Korea.
(No <i>A. agrarius.</i>	Dominant in Korea, absent from Japan.)

On the other hand, the Korean forms are :—

<i>Crocodyura corea.</i>	Replaced in Japan by <i>C. dsi-nezumi</i> .
<i>Felis microtis.</i>	No Cat of any sort known in Japan.
<i>Lutreola sibirica.</i>	Replaced in Japan by <i>L. itatsi</i> .

The balance even in mere numbers is thus on the side of the Japanese relationship of Tsu-shima. But further it is to be noted that three out of the four animals with Japanese affinities belong to special local subspecies, indicating that they are certainly indigenous, having been in the islands long enough to get more or less modified. On the other hand, all the Korean forms are identical with their mainland relatives and have perhaps been accidentally introduced through human agency.

Mr. Anderson's notes on the physical features of the islands are as follows :—

“Notes on Tsu-shima.

“Tsu-shima (literally Opposite Island) consists in reality of two main islands, the southern being called Shimono, the northern Kamino-shima. The two are separated by a narrow channel only, which, I am told, is sometimes dry at low tide. Both islands are hilly throughout, the highest point being 2100 ft. The hills are steep and their soil very thin, so, as the valleys are exceedingly narrow, arable land is scarce indeed, and the population almost entirely restricted to the fishing-villages on the coasts. The hills are wooded, especially in Kamino-shima, where pines, oaks, *Cryptomeria*, *Chamaecyparis*, and *Camelia* are the principal trees. Precipitation is abundant, but, owing to the shortness of the streams and the stony nature of the soil, which is composed of fragments of shale, the brooks are usually dry, especially at their lower ends; it is only during, or just after, a heavy rainfall that their water reaches the sea.

“Tsu-shima is surrounded by a few islets of no importance. The nearest land is Iki, 32 miles to the south-east, but the Korean mainland is not more than four or five miles farther, while some considerable islands of the Korean Archipelago are less than forty miles from Kamino. Between Shimono-shima and

Iki the sea reaches no greater depth than 65 fathoms (Japanese Admiralty chart), while between Kamino-shima and Korea it falls, in one restricted area near the coast of Kamino, to a depth of 105 to 118 fathoms.

"I collected in Tsu-shima from Jan. 1st to Feb. 3rd, 1907.

"No Hares or Squirrels are known to the people of Tsu-shima, and I could find no traces of *Evotomys* or *Microtus*, or indeed of any other wild species."—*M. P. A.*

In addition to the specimens collected by Mr. Anderson I have inserted references to a few mammals obtained by Mr. P. A. Holst in 1891 when travelling on behalf of the late Mr. Henry Seeböhm, by whom they were presented to the British Museum. Among these are the original examples of the Tsu-shima Marten, described by me in 1897. Two further new subspecies are now described.

After Tsu-shima Mr. Anderson visited the Iki and Goto Islands, the resulting collections proving that those groups are absolutely similar to S.W. Japan in their mammal fauna.

Mr. Anderson's series amounts to 151 skins, with their skulls, and is presented as before to the National Museum by His Grace the Duke of Bedford, K.G.

### 1. RHINOLOPHUS CORNUTUS Temm.

(92.3.20.1-2. P. A. Holst. 1891.)

This is the only Bat as yet recorded from Tsu-shima.

### 2. MOGERA WOGURA KANAI Thos.

(92.9.2.2. P. A. Holst. 1891.)

Unfortunately Mr. Anderson was not able to obtain further specimens of the Tsu-shima Mole, which I have provisionally assigned\*, on the single example above recorded, to the smaller south-western form *M. wogura*.

"Not secured or even seen, but natives tell of a black Mole, and also of a much larger buff-coloured one, which they say they see in spring and summer."—*M. P. A.*

### 3. UROTRICHUS TALPOIDES ADVERSUS†, subsp. n.

♂. 1243, 1244, 1272, 1274, 1275. ♀. 1263, 1273, 1279. Sasuna, N. Island. 100'.

♂. 1199, 1204, 1213, 1215, 1221, 1234. ♀. 1214. Izuhara, S. Island. 300'.

General colour very brown, furthest from the slaty black of the Hondo subspecies. Size less than in the Kiushiu form, the head and body measurement rarely attaining 90 mm. Tail comparatively long, averaging nearly 34 mm., its hairs also particularly long. Fur thick and soft—hairs of back about 6.5 mm. in length,

\* *Supra*, p. 463.

† Tsu-shima=Opposite Island.

and therefore nearly a millimetre longer than those of the more northern *U. t. hondonis*, measured equally on winter specimens.

Dimensions of the type:—

Head and body 89 mm.; tail 34; hind foot 15.

Skull—greatest length 26.5 mm.; basal length 22.3; greatest breadth 13.

*Hab.* Tsu-shima Islands—type from Sasuna, N. Island.

*Type.* Adult male. B.M. No. 8.2.26.1. Original number 1243. Collected 16th January, 1907.

“Fairly common in damp wooded ravines in Tsu-shima, where it was often trapped beneath or beside large stones. Insects are often among the stomach contents, and here no vegetable matter\* was recognised in their stomachs, but one example was caught in a trap baited with barley.”—*M. P. A.*

A renewed examination of the fine series of *Urotrichus* obtained by Mr. Anderson in the Japanese Archipelago shows that each of the three main islands has a form which may be subspecifically separated from the others, and that Tsu-shima has a fourth. Their characters are shown in the following synopsis:—

- |  |                                 |
|--|---------------------------------|
| A. Tail comparatively long, averaging about 33 mm.                             |                                 |
| a. Size larger, head and body 90–101 mm. Colour dark brown. Kiu-shiu.....      | <i>U. t. talpoides</i> Temm.    |
| b. Size smaller, head and body 84–91 mm. Colour paler brown. Tsu-shima.....    | <i>U. t. adversus</i> (suprà).  |
| B. Tail comparatively short.   |                                 |
| c. Tail averaging just over 30 mm. (range 28–34). Colour brown. Shi-koku ..... | <i>U. t. centralis</i> (infra). |
| d. Tail averaging 27 mm. (range 23–30). Colour slaty-grey. Hondo .....         | <i>U. t. hondonis</i> (infra).  |

The series on which these averages are based are from 15 to 22 in number, and are therefore large enough to eliminate any material error due to individual variation.

Details of the Shi-koku and Hondo subspecies:—

*UROTRICHUS TALPOIDES CENTRALIS* †, subsp. n.

Size averaging rather less than in true *talpoides*, larger than in *adversus* (head and body 90–97 mm., the majority of specimens 92–95). Tail decidedly shorter than in either *talpoides* or *adversus* (average of 22 specimens 30.75 mm., extremes 28–34). Fur about 6 mm. in length on the back (winter). General colour deep brown, darker than *adversus*, lighter than *talpoides*.

Dimensions of the type:—

Head and body 94 mm.; tail 32; hind foot 16; upper tooth-row 11.2.

*Hab.* Island of Shi-koku. Type from Jinrio, Tokushima Ken. Alt. 500'.

*Type.* Adult female. B.M. No. 6.1.4.68. Original number 289. Collected 14th February, 1905.

\* Cf. P. Z. S. 1905, ii. p. 341.

† Central as compared to other forms, both in size, colour, length of tail, and locality.

UROTRICHUS TALPOIDES HONDONIS, subsp. n.

*Urotrichus talpoides pilirostris* Thos. P. Z. S. 1905, ii. p. 342 (1906), nec *Dymecodon pilirostris* True, P. U. S. Nat. Mus. 1886, p. 97.

Size medium, head and body length generally about 90 mm. Tail shortest in the genus, the average of 17 specimens being 27 mm., with a range of from 23 to 30. Fur about 5.5 to 6 mm. in length on the back. General colour "slate-black" (grey No. 2), with a slight tinge of "mouse-grey," the brown tone found in the more western forms absent.

Dimensions of the type:—

Head and body 91 mm.; tail 26; hind foot 14; upper tooth-row 10.1.

*Hab.* Hondo. Type from Nakaomi, near Ohito, Izu.

*Type.* Male. B.M. No. 6.1.4.97. Original number 144. Collected 13th December, 1904.

This form needs a name different from that I applied to it in 1905, for the reasons explained in the footnote\*.

4. CROCIDURA COREÆ THOS.

♀. 1242-1247. Sasuna, N. Island.

♂. 1203. Izuhara, S. Island.

This is one of the three Tsu-shima species of Korean rather than Japanese affinity, but must not be considered as of great importance from a geographical standpoint, as Shrews of this genus are undoubtedly often carried about on shipboard from place to place, so that this Shrew may have been accidentally introduced from Korea.

"Rare. None seen but the three preserved."—M. P. A.

\* Since I wrote the paper on Japanese Mammals above referred to, the Museum has received from Mr. K. Kanai, a Japanese who had been taught collecting by Mr. Anderson, a small series of specimens from Central Southern Hondo. Among these there are four examples of an Insectivore entirely new to us, allied to *Urotrichus*, but smaller and differing in various details, and it seemed probable, therefore, that these represented Mr. True's *Dymecodon pilirostris*, which had been supposed to have been based on a young *Urotrichus*.

By Mr. True's kindness and the great courtesy of the authorities of the United States National Museum I have been permitted the loan of the type specimen of *D. pilirostris*, and a comparison shows at once that the above suggestion is correct, and that Mr. Kanai's specimens represent the adult and Mr. True's type the young of a species generically quite distinct from *Urotrichus*. I am therefore now able to confirm the absolute correctness of Mr. True's distinction of *Dymecodon*, on which I had previously thrown doubt.

The adult dentition of *Dymecodon* does not differ in number from that of the young described by Mr. True, and appears to be, so far as I am able to understand the homologies of the teeth,

$$\begin{array}{rcccl} & 1.2.3 & 1 & 1.0.3.4 & \\ I. & \frac{1.2.3}{0.2.3} & C. \frac{1}{1} & P. \frac{3.4}{3.4} & M. \frac{1.2.3}{1.2.3} \\ & 0.2.3 & 1 & 1.0.3.4 & \end{array}$$

the permanent  $p^1$  being present with the milk-teeth, and being included in the number recorded by Mr. True. The formula of *Urotrichus* is the same, except that the lower canine is absent, the statement made by some authors that there are four

5. *FELIS MICROTIS* M.-Edw.

♀. 1198, 1278. Sasuna, N. Island. 300'.  
(91.10.14.1, 92.1.11.3, and 96.2.28.1. P. A. Holst. 1891.)

This is an essentially Korean member of the Tsu-shima fauna, no member of the genus *Felis* being found in Japan.

"The Wild Cat is common in Tsu-shima, living near the sea-shore, where it is said to go nightly at low tide to fish. In the stomach of 1278 I found fish-bones and some feathers of the pheasant. The natives consider the flesh of the Cat especially delicate food. Native name: 'Yama-niku' = Mountain-Cat."—*M. P. A.*

6. *MARTES MELAMPUS TSUENSIS* Thos.

♂. 1261–1277. Sasuna, Tsu-shima.  
(91.10.14.2–3, 92.1.11.1–2. P. A. Holst. 1891.)

When describing this form in 1897\* I had not any Japanese Martens of the *bedfordi* type to compare it with, that being clearly the animal to which it is most allied, and not the typical *melampus*. Now, however, a comparison of Mr. Anderson's skins of the two shows that, in winter pelage, the Tsu-shima Marten is distinguishable from that of Southern Hondo by its whitish crown and the absence of the yellowish tuft at the end of the tail.

"Common in Northern Tsu-shima, and occurring in the South Island. Like the Cat it is most often found near the sea. The stomachs of the two caught were empty, but the animals were excessively fat. They are considered a fine food by the peasantry of the islands, who call them 'Wata-boshi' = Cotton-cap."—*M. P. A.*

premolars and only  $\frac{2}{3}$  incisors being evidently wrong, as a comparison of the milk and permanent teeth both of *Dymecodon* and *Urotrichus* shows that the antepenultimate premolar does not change, and is therefore  $p_1$ , while distinct traces of the premaxillo-maxillary suture can be seen just behind the third tooth in the upper jaw. Of the incisors it is probably  $i_1$  that is missing in the lower jaw.

In the form and relative proportions of the permanent teeth *Dymecodon* resembles *Urotrichus* very closely, the curious alternation in size of the lower teeth, on which Mr. True based the name of the genus, not existing in the later dentition, and it is in fact only due to the milk  $p_2$  being, not unnaturally, smaller than the permanent  $p_1$ , which coexists with it.

But in the milk stages, which have not previously been compared, the differences are far greater. For while in *Dymecodon* the two anterior incisors are subequal, similar in form, scarcely overtop the teeth posterior to them, and in Mr. True's words "resemble the teeth of *Phocæna*," those of *Urotrichus* have already progressed a long way towards the specialisation found in the adults of both genera,  $mi^1$  considerably surpassing  $mi^2$ , and this again being much longer than  $mi^3$ ; and below again the most anterior tooth ( $mi_2$ , as I suppose) is decidedly longer than any of the next three teeth.

From this it would appear that *Dymecodon* is in a more primitive stage of evolution than *Urotrichus*.

Mr. Kanai's specimens of *Dymecodon* were captured at Shibu, on Mt. Yatsugatake, Nagano Ken, N.W. of Yokohama, at an altitude of 5700'.

Mr. Kanai also obtained at Kamisawa-machi, in the same Ken, an example of *Vespertilio murinus superans* Thos., a Bat new to the fauna of Japan.

\* Ann. Mag. N. H. (6) xix. p. 161 (1897).

7. *LUTREOLA SIBIRICA* Pall.

♂. 1262, 1269, 1276. Sasuna, N. Island.

These specimens agree absolutely in size, colour, and length of tail with Vladivostok and other mainland examples of the group, and equally differ from the Japanese *Putorius itatsi*.

On the other hand, the Quelpart Minks, which I had supposed to be summer representatives of *sibiricus*, prove on a closer examination to be more allied to *itatsi*, though separable from it\*. In both islands, therefore, the members of the present genus exactly contradict the conclusions as to the faunistic relations of Quelpart and Tsu-shima with Korea and Japan, indicated by *Urotrichus* and the Mice.

"The most common of the Carnivora of the Islands; not living near houses, but in the wooded hills. Sometimes eaten by the fishermen. Called 'Yoto-shi' = Night-thief."—*M. P. A.*

8. *MUS NORVEGICUS* Erxl.

♂. 1267. ♀. 1268. Sasuna, N. Island.

"Common on the sea-shore, where I found it living among the rocks. Fishermen told me that it swims in the sea."—*M. P. A.*

9. *APODEMUS SPECIOSUS* Temm.

♂. 1252, 1270. ♀. 1250, 1251, 1253, 1264, 1271, 1280. Sasuna, N. Island. 100'.

♂. 1202, 1207, 1210, 1227, 1236, 1241. ♀. 1201, 1208, 1220 1239. Izuhara, S. Island. 300'.

These specimens are absolutely *speciosus* and not *peninsulae*, thus agreeing with the other Rodents in their Japanese rather than Korean relationship.

\* *LUTREOLA QUELPARTIS*, sp. n.

Size as in *P. itatsi*, the Japanese Mink, markedly smaller than in the Korean *P. sibiricus*. General colour, in summer pelage, dark tawny or russet-brown, quite as in *P. itatsi*. Face dark "seal-brown"; under surface, tail, and sides of neck russet; lips and chin white; hands and feet russet, passing terminally into drab.

Skull with a very high and vaulted brain-case, much more so than that of either *P. sibiricus* or *itatsi*. Upper molar with its inner lobe narrow, the antero-posterior diameter of this lobe little or not more than that of the outer lobe, and therefore much reduced as compared with either of the allied forms, in which there is a broadly expanded inner lobe.

Dimensions of a pair, measured in flesh:—

♂ (Type). Head and body 309 mm.; tail 153; hind foot 55; ear 25.  
♀. " " 265 " ; " 130; " 46; " 22.

♂ (type). ♀.

Skull—condylo-basal length .....	57.5	50.5
basal length .....	54	47.3
mastoid breadth .....	25.7	22.5
combined height of brain-case and bullae .....	21.5	17.8
inner lobe of m <sup>1</sup> , antero-posterior diameter] ...	2.2	2

*Hab.* Island of Quelpart, S. of Korea.

*Type.* Adult male. B.M. No. 6.12.6.1. Original number 627. Collected 7th September, 1905, by M. P. Anderson; presented by the Duke of Bedford, K.G. (Four specimens examined.)

Four fairly large specimens measure :—

♂. Head and body	107 mm.	; tail	100	; hind foot	25.5	; ear	16.
♂.               "	104	" ; "	98	"       "	25	" ; "	15.5.
♀.               "	97	" ; "	96	"       "	25.5	" ; "	16.
♀.               "	96	" ; "	93	"       "	24.5	" ; "	16.5.

10. *APODEMUS GEISHA SAGAX*, subsp. n.

♂. 1245, 1246, 1249, 1254, 1255, 1256, 1257, 1258. ♀. 1248, 1259, 1260, 1265, 1266. Sasuna, N. Island. 100'.

♂. 1206, 1211, 1212, 1217, 1222, 1224, 1225, 1228, 1230, 1231, 1232, 1237, 1240. ♀. 1200, 1205, 1209, 1216, 1218, 1219, 1223, 1226, 1229, 1233, 1238, 1239. Izuhara, S. Island. 200'–300'.

General characters as in true *geisha*, but just as the ears average shorter in specimens from Hokkaido\*, so here they are uniformly rather longer than in Hondo examples. Of the 25 specimens from Izuhara, in the S. Island of Tsu-shima, no less than 16 are labelled as having ears 15 mm. in length, three have them 14, two 14.5, two 15.5, and two 16. In true *geisha* the ears are about 14 mm., and in *hokkaidi* 13 mm.

The Sasuna specimens are not quite so uniform as those from Izuhara.

Dimensions of four specimens from Izuhara :—

♂. Head and body	81 mm.	; tail	91	; hind foot	19.5	; ear	15.
♂ (Type)       "	79	" ; "	100	"       "	19.5	" ; "	15.
♀.               "	84	" ; "	90	"       "	19	" ; "	16.
♀.               "	75	" ; "	83	"       "	19.5	" ; "	15.5.

Skull of type—greatest length 24 mm.; basilar length 18; length of upper tooth-series 3.5.

*Hab.* Tsu-shima—type from Izuhara, South Island.

*Type.* Adult male. B.M. No. 8.2.26.50. Original number 1228. Collected 10th January, 1907.

"The most common of the Tsu-shima mammals. Found in the forested hills and canyons."—*M. P. A.*

Purely a Japanese type, no Mouse at all allied occurring in Korea.

11. *APODEMUS MINUTUS* Pall.

♂. 1235. Izuhara, S. Island.

Head and body 54 mm.; tail 53; hind foot 14.5; ear 9.

The single specimen appears to be more or less intermediate between the continental subspecies *ussuricus* and the Japanese *japonicus*, but no very definite opinion can be expressed about it without further material.

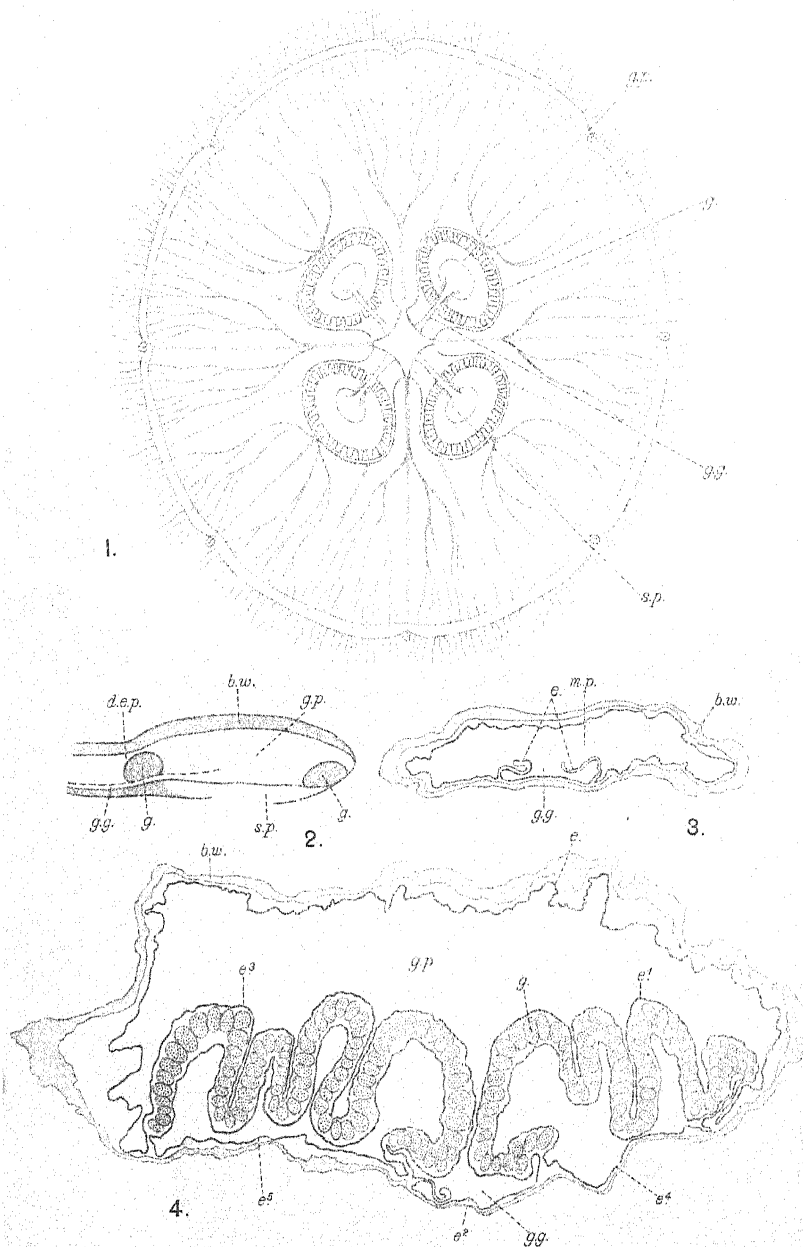
[12. *CERVUS SIKA* Temm.

"Said to have been very abundant before the introduction of good firearms; now rare and not seen by me or my assistant."—*M. P. A.*]

\* *M. g. hokkaidi*, P. Z. S. 1905, ii. p. 350.







T.G. del.

E. Wilson, Cambridge.

GONADIAL GROOVES IN AURELIA AURITA.

2. On the Presence of Gonadial Grooves in a Medusa, *Aurelia aurita* \*. By T. GOODEY, †Student Demonstrator in Zoology, University of Birmingham.

[Received December 23, 1907.]

(Plate I.†)

While recently examining specimens of the Scyphozoon *Aurelia aurita* in the ordinary course of practical work in the Zoological Laboratory, the structures mentioned in the title of this paper attracted my attention. It was not clear that they formed any part of the ordinary radial canal-system, and, so far, I have been unable to find any account of them in the different text-books and journals which I have consulted in the expectation of obtaining information as to their nature. This being the case, it seemed desirable to investigate the nature and relations of the structures in question and to give a brief account of the results.

The gonadial grooves were found in all the preserved specimens examined in the laboratory, both male and female, and they were also found in living examples which came under my notice during the recent summer vacation.

In a view of the sub-umbrella surface (Pl. I. fig. 1) the four grooves were easily visible to the naked eye, and presented the appearance of four radially arranged canals. Each groove (*g.g.*) lies in an inter-radial axis, and is better seen when the prolonged mouth-angles have been removed. It has about the same diameter as the origin of an ordinary per-radial or ad-radial canal, and extends from the central gastric cavity into a gastric pouch (*g.p.*), where it terminates in a somewhat funnel-like expansion at about the centre of the pouch and directly dorsad to the external opening of the corresponding sub-genital pit (*s.p.*). In its course the groove extends along the ventral wall or floor of the passage from the gastric cavity to the pouch and along the floor of the pouch itself.

Bristles could readily be passed along the groove, and by means of a fine pipette a coloured liquid was injected through the groove into the gastric pouch. When the latter became filled and more of the liquid was injected, the excess began to flow back into the gastric cavity through the main opening into the pouch (Pl. I. fig. 2, *d.e.p.*) which is dorsad to, and considerably wider than, the groove in question.

At first sight the grooves appeared to be the beginnings of inter-radial canals; but the fact that each groove does not extend beyond the centre of each gastric pouch, and also that at this point it widens out and abruptly terminates, negatives this idea.

In order to determine the true nature of these structures, portions of the Medusa, including complete gastric pouches and

\* Communicated by Professor BRIDGE, F.R.S., F.Z.S.

† For explanation of the Plate, see p. 58.

their connections with the central gastric cavity, were removed. These were then stained with borax carmine for forty-eight hours, dehydrated, and embedded in paraffin-wax. Sections were cut at right angles to the inter-radial, passing completely through the pouches from the dorsal to the ventral surfaces. In the above preparation there was a considerable amount of contraction due to the jelly-like consistency of the material, and, for this reason, many of the parts in several of the sections were displaced from their natural relations.

From an examination of the most satisfactory complete sections, however, the nature and relations of the grooves could be easily made out. It was at once evident that they were not closed canals similar to the normal radial canals, and that their resemblance to canals in a superficial or surface view was misleading.

Each groove is, in fact, formed by a folding of the endodermal epithelium lining the floor of the pouch and of its passage of communication with the gastric cavity. This folding is shown in Pl. I. fig. 3, where the epithelium is seen to be raised into two parallel ridges (*e*), one on each side of a median vertical line, which form the somewhat folded lateral walls of the groove (*g.g.*).

In the floor of each pouch, almost completely encircling its outer, lateral, and inner walls, is situated the gonad (figs. 1, 2, & 4, *g.*), in the form of a characteristic incomplete ring of sex-cells, the discontinuity occurring at the point where the groove enters the pouch.

From Pl. I. fig. 4 it will be seen that the endodermal epithelium (*e*, *e*<sup>1</sup>, *e*<sup>2</sup>, *e*<sup>3</sup>) not only lines the inner surface of the gastric pouch and invests the gonad above, but also extends downwards in the median line so as to form the boundaries of the gonadial groove (*g.g.*). An epithelial stratum (*e*<sup>4</sup>, *e*<sup>5</sup>) also invests the ventral or oral surface of the gonad, and is continuous with that lining the floor of the gastric pouch. Thus the gonad is completely ensheathed by the endoderm from which the sex-cells are derived. As this section passes through the point of discontinuity of the gonad-ring, it will be noticed that the two halves of the ring lie one on either side of a median line along which the gonadial groove passes into the gastric pouch.

The function of these problematic grooves is by no means so easy to determine as their structure and relations. That they have anything to do with the conveyance of food-material from the gastric cavity to the gastric pouches is highly improbable, inasmuch as these cavities are already in free and open communication with one another. A more feasible suggestion is that they function as channels for the outward conveyance of the ripe sex-cells when liberated from the gonads. Their position in the gastric pouches and their somewhat expanded origins in close relations with the encircling gonads, seem to point to this conclusion. The liberated sex-cells would fall on to the floor of a gastric pouch, and the gonadial groove would seem to constitute

an obvious and natural channel for their transit to the exterior. The groove is not closed dorsally, it is true, but the epithelial ridges bounding the groove seem capable of approximating sufficiently closely that it is by no means difficult to imagine the groove as practically a closed canal—a functional gonoduct, in short.

It must be admitted that I have not been able to detect the presence of sex-cells in the gonadial grooves, but this may be due to the fact that the gonads were not mature, or the sex-cells ripe for extrusion. It remains for further investigation to ascertain on living specimens under suitable conditions whether these views as to the nature and function of the gonadial grooves are correct.

A careful examination of *Pelagia noctiluca* and *Chrysaora isosceles*, both of which belong to the Pelagidæ, failed to reveal the existence in either species of any structures comparable to the gonadial grooves of *Aurelia aurita*.

In conclusion, it may be suggested that the observations recorded above possess certain features of more general interest.

In discussing the evolution of the cœlom Sir Ray Lankester\* remarks:—"We may suppose the first cœlom to have originated by the closing or shutting off of that portion of the general archenteron of Enterocœla in which the gonads develop, as in *Aurelia* or as in Ctenophora"; and, further, "the most important developments of the cœlom are in connection with the establishment of an exit for the generative products through the body-wall to the outer world." If, therefore, my observations and inferences as to the nature and function of the gonadial grooves be correct, it is obvious that in this organism we have an extremely interesting and primitive condition.

The gastric pouches are special portions of the archenteron, from the walls of which the gonads have their origin; they are, in fact, primitive gonocœles, although not yet completely shut off from the general archenteric cavity as is the case in so many Cœlomata. On the other hand, the gonadial grooves may be regarded in the light of incipient cœlomoducts or gonoducts which in like manner are still but imperfectly constricted off from the archenteron. Consequently the gonadial grooves and gastric pouches of *Aurelia* seem to represent a very primitive stage in the evolution of both gonocœles and gonoducts.

It has generally been held that, with one exception, the Cœlenterata have no specially differentiated genital ducts, the sex-cells finding their way to the exterior either directly by the external dehiscence of the gonads, or indirectly by internal dehiscence into archenteric canals or spaces and thence outwards through the mouth. The single exception referred to is in the case of *Ctenoplana korotneffi*, the aberrant Ctenophor discovered by Willey† in 1896 in the Eastern Archipelago of British New Guinea, in which, however, only male gonads were found.

\* A Treatise on Zoology, part ii. 1900, p. 9.

† Quart. Journ. Micros. Science, vol. 39, n. s. 1896-97.

According to the discoverer, the two pairs of gonads apparently had their origin from endodermal cell proliferations of the walls of genital diverticula of the general archenteric canal-system, as in so many other Cœlenterata. Special genital ducts are present, but variable in number, and they are described as being continuous with the tunica propria investing the gonads. The external apertures of the ducts are situated on the dorso-lateral surfaces of the body, below several of the ctenophoral bands.

In the present state of our knowledge of the genital ducts of *Ctenoplana korotneffi*, and especially in the absence of any information as to their mode of origin, any attempt to discuss the question of their morphological character would be of little value. It may therefore be concluded, at any rate provisionally, that, while both *Aurelia* and *Ctenoplana* stand alone among living Cœlenterata in possessing genital ducts, it is nevertheless only in the Scyphozoon that these structures can at present be regarded as cœlomic or archenteric derivations, and, in fact, are a very primitive form of cœlomoduct or gonoduct.

I am indebted to Professor Bridge for the kindness and consideration which he has shown to me in these my first attempts at independent investigation, and also to Mr. F. W. Crispe for the material help given in the preparation of the sections.

#### EXPLANATION OF PLATE I.

Gonadial grooves in *Aurelia aurita*.

- Fig. 1. Surface view of sub-umbrella aspect of *Aurelia aurita*, the prolonged mouth-angles having been removed. The gonadial grooves are shown, and also their relations to the surrounding structures.
- Fig. 2. Semi-diagrammatic, enlarged three times. The gastric pouch has been cut through along the inter-radius, and the drawing represents a view taken in the vertical plane. The space between the dotted line and the body-wall represents the course of a gonadial groove from the gastric cavity to its opening into the gastric pouch.
- Fig. 3. ( $\times 20$ ) Section passing through the main passage to a gastric pouch, showing the gonadial groove lying in a median position in the ventral wall, bounded on either side by an endodermal epithelial fold.
- Fig. 4. ( $\times 20$ ) Section passing through a gastric pouch, showing a gonadial groove in the floor, and the loops of the gonad ring bounding it on every side.

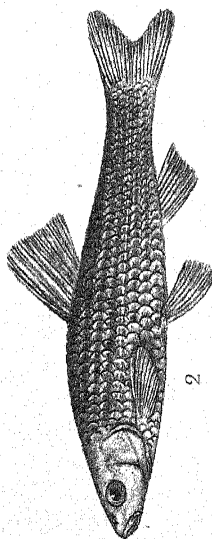
#### REFERENCE LETTERS.

*b.w.*, body-wall; *d.e.p.*, dorsal entrance to a gastric pouch; *e.* (fig. 3), epithelial folds; *e.*, *e*<sup>1</sup>, *e*<sup>2</sup>, *e*<sup>3</sup>, epithelium lining inside of pouch and covering gonad above; *e*<sup>1</sup>, *e*<sup>2</sup>, epithelium of ventral surface of the gonad and of the floor of a gastric pouch; *g.*, gonad; *g.g.*, gonadial groove; *g.p.*, gastric pouch; *m.p.*, main passage from the gastric cavity to a gastric pouch; *s.p.*, sub-genital pit.

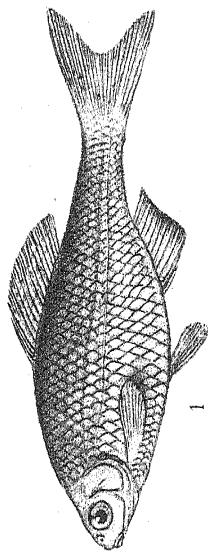
[March 9th, 1908.—Since writing this paper my attention has been directed by Mr. E. T. Browne of University College, London, to a paper published by L. Agassiz in 'Contributions to the Natural History of the United States,' vols. iii. & iv. 1860-62, dealing with *Aurelia flavidula*, which is now considered to be the same as *Aurelia aurita*.

In his account L. Agassiz explains that the gastric pouches

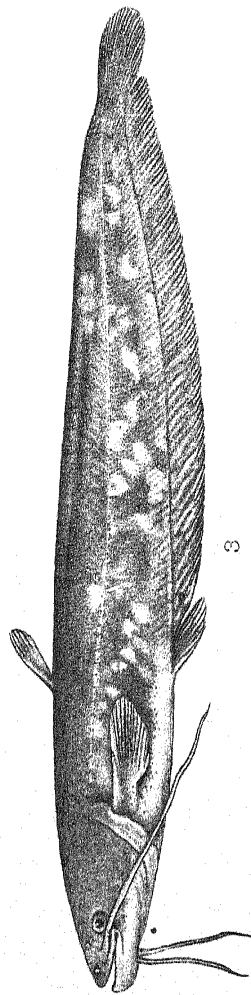




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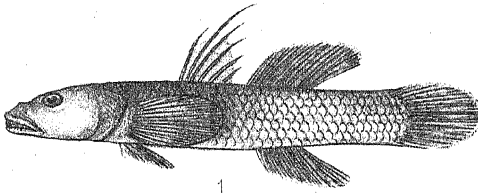
G.M. Woodward del et lith.

1. ACANTHORHODEUS GRACILIS. 2. LEUCOGOBIO STRIGATUS.  
3. SILURUS BEDFORDI.

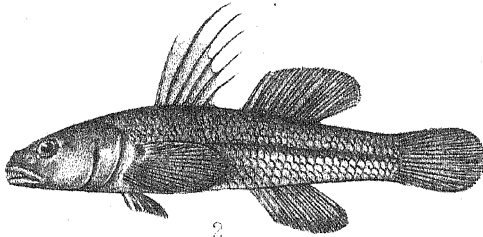
West, Newman imp.



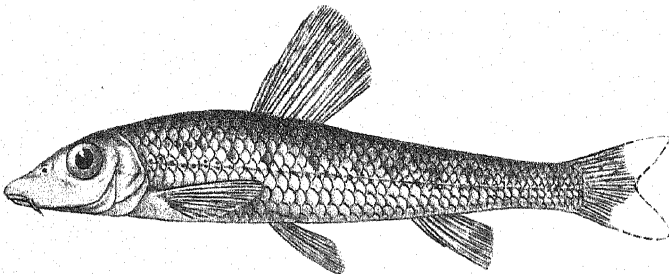




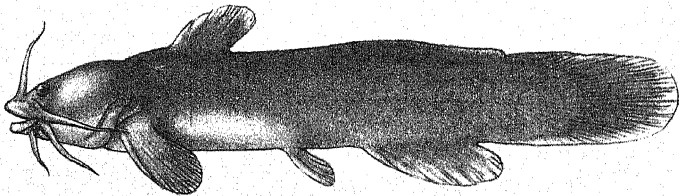
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G. M. Woodward del. et lith.

West, Newman imp.

1. CTENOGOBIOUS BEDFORDI. 2. TRIDENTIGER COREANUS.  
3. ACANTHOGOBIO LONGIROSTRIS. 4. LILOBAGRUS ANDERSONI.

retain a connection with the central gastric cavity by means of channels along which the sex-cells pass on their way to the exterior. These channels, I take it, are the *main passages* of connection between the gastric pouches and the central gastric cavity referred to in the above paper.

L. Agassiz makes no reference, either written or by figure, to the ridges of epithelium which form the boundaries of the "gonadial grooves" in the above account.

It should be noted that it is within the limits of these grooves that it is suggested the sex-cells pass on their way to the exterior at the period of extrusion, and that it is only these parts which form the primitive gonoduct by a pinching-off from the arch-enteric cavity.]

3. The Duke of Bedford's Zoological Exploration in Eastern Asia.—VIII. A Collection of Fresh-water Fishes from Corea. By C. TATE REGAN, M.A., F.Z.S.

[Received January 14, 1908.]

(Plates II. & III. \*)

A small series of fresh-water fishes collected in Corea by Mr. M. P. Anderson and presented to the British Museum by His Grace the Duke of Bedford, K.G., is of considerable interest, as of the eleven species represented, no less than seven are new to science, some of these extending the range of genera previously known from China or Japan. The specimens are from two localities, viz., Chong-ju, Chung-Chong province, and Kimhoa, 65 miles north-east of Seoul; from the latter examples of only two species (*Silurus bedfordi* and *Liobagrus andersoni*) were obtained.

CYPRINIDÆ.

1. *CARASSIUS AURATUS* L.
2. *PSEUDORASBORA PARVA* Schleg.
3. *BARILIUS PLATYPUS* Schleg.
4. *LEUCOGOBIO STRIGATUS*, sp. n. (Plate II. fig. 2.)

Depth of body equal to or a little more than the length of head, which is 4 in the length of the fish. Snout a little longer than eye, the diameter of which is 4 in the length of head; interorbital width  $2\frac{2}{3}$  to 3 in the length of head. Mouth oblique; barbels small. Dorsal 10, with 7 branched rays; origin equidistant from tip of snout and base of caudal and above that of the ventrals. Anal 9, with 6 branched rays. Pectoral not reaching the ventrals. Caudal forked. 36 to 38 scales in a longitudinal

\* For explanation of the Plates, see p. 63.

series, 4 or 5 in a transverse series from origin of dorsal to lateral line, 3 or  $3\frac{1}{2}$  between lateral line and base of ventral fin. Dark longitudinal stripes along the series of scales, broader and stronger above the lateral line, fading out below; fins pale.

Three specimens from Chong-ju, the largest 75 mm. in total length.

The genus *Leucogobio* has hitherto included one species from Corea, two from Western China and four from Japan. Of these the Chinese *L. taeniatus* Gthr., 1896, and the Japanese *L. guentheri* Ishikawa, 1901, are very similar to *L. strigatus*, but differ from it in coloration and in having more scales in a transverse series.

5. *ACANTHOGOBIO LONGIROSTRIS*, sp. n. (Plate III. fig. 3.)

Depth of body  $4\frac{2}{3}$  in the length, length of head  $3\frac{2}{3}$ . Snout long, decurved,  $1\frac{3}{5}$  as long as eye, the diameter of which is  $3\frac{1}{4}$  in the length of head and equal to the width of the flat interorbital area. Mouth small, inferior, horseshoe-shaped; barbel shorter than the eye. Dorsal II 7; origin equidistant from tip of snout and base of caudal. Anal 8, with 6 branched rays. Pectoral nearly reaching the ventrals, which are inserted below the anterior rays of the dorsal. 43 scales in a longitudinal series,  $5\frac{1}{2}$  in a transverse series from origin of dorsal to lateral line,  $3\frac{1}{2}$  between lateral line and base of ventral. Silvery, back darker; blackish spots on the back and on the sides above the lateral line; small dark spots on dorsal and caudal.

A single specimen, 95 mm. in total length, from Chong-ju.

The pharyngeal teeth appear to be in two series (5. 2—2. 5); but this species is not very remote from *Hemibarbus barbatus* Schleg., and it seems to me that the genus *Acanthogobio* Herz., 1892, is scarcely worth recognition, as it differs from *Hemibarbus* only in having the pharyngeal teeth in 2 series instead of 3.

6. *ACANTHORHODEUS GRACILIS*, sp. n. (Plate II. fig. 1.)

Depth of body  $2\frac{3}{5}$  to  $2\frac{3}{4}$  in the length, length of head  $4\frac{1}{4}$ . Snout a little shorter than eye, the diameter of which is 3 to  $3\frac{1}{3}$  in the length of head; interorbital width  $2\frac{1}{2}$  in the length of head. Mouth small; no barbels. Dorsal II 13; second spine nearly  $\frac{2}{3}$  the length of head, considerably shorter than the longest soft rays, which are nearly as long as the head; fin highest anteriorly; free edge slightly convex. Anal II 10; second spine  $\frac{1}{2}$  or a little more than  $\frac{1}{2}$  the length of head; free edge slightly concave. Pectoral nearly reaching the ventrals, which extend nearly to the anal. 34 scales in a longitudinal series, 6 or 7 in a transverse series from origin of dorsal to lateral line, 5 or 6 between lateral line and base of ventral. Silvery, back olivaceous; a bluish lateral stripe on the posterior part of the body; dorsal with alternating series of pale and dark spots on the rays; anal with a narrow blackish edge.

Two specimens, 65 and 70 mm. in total length, from Chong-ju.

## SILURIDÆ.

7. *SILURUS BEDFORDI*, sp. n. (Plate II. fig. 3.)

Depth of body 6 in the length, length of head  $4\frac{1}{2}$  to  $5\frac{1}{2}$ . Breadth of head about  $1\frac{1}{3}$  in its length, diameter of eye  $7\frac{1}{2}$  to 9, interocular width  $1\frac{5}{8}$  to 2, length of snout  $3\frac{1}{2}$  to  $3\frac{3}{4}$ . Lower jaw projecting; vomerine patches of teeth either narrowly separated or united anteriorly. Four barbels, the mandibular ones less than  $\frac{2}{3}$  as long as the maxillary ones, which extend nearly to the posterior end of the pectoral fin (adult) or beyond (young). Gill-rakers short, 6 to 9 on the lower part of the anterior arch. Dorsal 5, its distance from the end of snout  $\frac{1}{2}$  its distance from the caudal (young) or less (adult). Anal 73-78, continued on to the caudal. Pectoral spine stout, its length a little more than  $\frac{1}{2}$  that of the fin or nearly  $\frac{1}{3}$  the length of head; outer edge roughened or finely serrated, inner edge entire. Ventrals with 13 rays. Caudal subtruncate. Adult uniformly greyish (in spirit); young dark greenish above, yellowish below, with the sides and anal fin marbled.

Two specimens, 130 and 275 mm. in total length, one from Kimhoa, the other from Chong-ju.

This species is closely allied to *Silurus asotus* L., from China and Japan, which differs especially in the longer pectoral spine with both edges serrated. From *S. grahami* Regan, from Yunnan, with which it agrees in the structure of the pectoral spine, *S. bedfordi* is distinguished by the broader head, shorter snout, and shorter pectoral spine ( $\frac{2}{3}$  the length of head in *S. grahami*).

8. *LIOBAGRUS ANDERSONI*, sp. n. (Plate III. fig. 4.)

Depth of body 6 in the length, length of head  $4\frac{3}{4}$ . Head nearly as broad as long; interocular width 3 in the length of head. Jaws equal anteriorly; præmaxillary band of teeth 2 to  $2\frac{1}{2}$  as long as broad; posterior mandibular barbel extending to basal part of pectoral. Dorsal 15; spine  $\frac{2}{3}$  the length of head. Pectoral spine  $\frac{2}{3}$  the length of the fin, which is  $\frac{2}{3}$  the length of head. Anal 15. Caudal rounded or subtruncate. Greyish; fins more or less dusky, with pale edges.

Three specimens from Kimhoa, 65 miles north-east of Seoul, the largest 110 mm. in total length.

The genus *Liobagrus*, established by Hilgendorf in 1878, is now known to include six species, which may be distinguished by the following synopsis:—

- I. Jaws equal anteriorly or the lower slightly projecting; depth of body about 6 in the length; interocular width  $2\frac{1}{4}$  to 3 in the length of head.  
 Length of head  $3\frac{1}{2}$  to  $3\frac{3}{4}$  in the length of the fish; præmaxillary band of teeth 4 times as long as broad; posterior mandibular barbel extending to base of pectoral or slightly beyond; dorsal spine  $\frac{2}{3}$  the length of head ..... *nigricauda*.

Length of head 4 in the length of the fish; premaxillary band of teeth nearly 3 times as long as broad; posterior mandibular barbel extending to middle of pectoral; dorsal spine a little more than  $\frac{1}{2}$  the length of head ..... *marginatus*.

Length of head  $4\frac{3}{4}$  in the length of the fish; premaxillary band of teeth 2 to  $2\frac{1}{2}$  as long as broad; posterior mandibular barbel extending to basal part of pectoral; dorsal spine  $\frac{2}{3}$  the length of head ..... *andersoni*.

II. Lower jaw shorter than the upper.

A. Interocular width  $2\frac{3}{4}$  to 3 in the length of head.  
Depth of body 6 to 7 in the length; premaxillary band of teeth  $2\frac{1}{2}$  to 3 as long as broad; dorsal spine  $\frac{1}{2}$  the length of head; pectoral spine less than  $\frac{1}{2}$  the length of the fin ..... *styani*.

Depth of body about 6 in the length; premaxillary band of teeth  $2\frac{1}{2}$  as long as broad; dorsal spine  $\frac{1}{2}$  the length of head; pectoral spine more than  $\frac{1}{2}$  the length of the fin ..... *reini*.

B. Interocular width 2 to  $2\frac{1}{2}$  in the length of head.  
Depth of body  $4\frac{3}{4}$  to 5 in the length; premaxillary band of teeth twice as long as broad; dorsal spine  $\frac{1}{2}$  the length of head; pectoral spine less than  $\frac{1}{2}$  the length of the fin ..... *sugubii*.

LIOBAGRUS NIGRICAUDA.

Regan, Ann. Mag. Nat. Hist. (7) xiii. 1904, p. 193.

Hab. Yunnan.

LIOBAGRUS MARGINATUS.

*Amblyceps marginatus* Günth. Pratt's "Snows of Thibet," Appendix, p. 245, pl. ii. fig. A (1892).

Hab. Sze-chuen Province, China.

LIOBAGRUS ANDERSONI, sp. n.

Hab. Corea.

LIOBAGRUS STYANI.

Regan, Ann. Mag. Nat. Hist. (8) i. 1908, p. 152.

Hab. South Hupeh, China.

LIOBAGRUS REINI.

Hilgendorf, Sitzungsab. Gesellsch. naturf. Freund. Berlin, 1878, p. 1; Jord. & Fowler, Proc. U.S. Nat. Mus. xxvi. 1903, p. 909, fig. 2.

Hab. Southern Japan.

LIOBAGRUS SUGUBII.

Regan, Ann. & Mag. Nat. Hist. (8) i. 1908, p. 152.

Hab. L. Biwa, Japan.

Gobiidae.

9. ODONTOBUTIS POTAMOPHILUS Gthr.

10. CTENOGOBIOUS BEDFORDI, sp. n. (Plate III. fig. 1.)

Depth of body  $5\frac{1}{2}$  to 6 in the length, length of head  $3\frac{1}{4}$  to  $3\frac{1}{3}$ . Snout longer than eye, the diameter of which is 5 in the length of head and twice the interorbital width. Jaws equal anteriorly;

maxillary extending to the vertical from the anterior edge of eye; head naked; nape covered with small scales. Dorsal VI, I 8; second ray of spinous dorsal produced into a filament. Anal I 8. Caudal rounded. Pectoral  $\frac{3}{4}$  the length of head; ventrals extending less than  $\frac{1}{2}$  the distance from their base to the anal. 36 to 38 scales in a longitudinal series. Brownish olive; fins dusky; caudal with small dark spots; vertical fins with a narrow pale edge.

Two specimens, 70 and 75 mm. in total length, and some smaller ones not included in the description, from Chong-ju.

#### 11. TRIDENTIGER COREANUS, sp. n. (Plate III. fig. 2.)

Depth of body 5 in the length, length of head  $3\frac{2}{5}$ . Snout longer than eye, the diameter of which is 5 in the length of head and equal to the interorbital width. Head nearly twice as long as broad; cheeks not tumid. Jaws equal anteriorly; maxillary extending to below anterior part of eye. Dorsal VI, I 11; rays of spinous dorsal produced into filaments. Anal I 9. Pectoral  $\frac{5}{6}$  the length of head. 42 scales in a longitudinal series. Brownish; a more or less distinct dark lateral stripe, edges of scales darker; fins dusky, the pectoral with a blackish spot margined posteriorly by a pale crescent on the upper part of its base, the anal with a dark intramarginal stripe.

A specimen of 70 mm. and several much smaller ones not included in this description, from Chong-ju.

### EXPLANATION OF THE PLATES.

#### PLATE II.

- Fig. 1. *Acanthorhodus gracilis*.  
2. *Leucogobio strigatus*.  
3. *Silurus bedfordi*.

#### PLATE III.

- Fig. 1. *Otenogobius bedfordi*.  
2. *Tridentiger coreanus*.  
3. *Acanthogobio longirostris*.  
4. *Liobagrus andersoni*.

February 18, 1908.

DR. HENRY WOODWARD, F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions made to the Society's Menagerie during the month of January 1908:—

The number of registered additions to the Society's Menagerie during the month of January was 173. Of these 125 were acquired by presentation and 23 by purchase, 9 were received on deposit, 6 by exchange, and 10 were bred in the Gardens.

The number of departures during the same period, by death and removals, was 234.

Among the additions special attention may be directed to:—

One Crowned Sifaka (*Propithecus diadema*), from Madagascar, new to the Collection, deposited on Jan. 2nd.

Three Caucasian Ibexes (*Capra cylindricornis*), from Lagodeiki, S.E. Caucasus, presented by Prince Paul Demidoff on Jan. 16th.

Two Greater Birds of Paradise (*Paradisaea apoda*), either females or immature males, from New Guinea, presented by Sir William Ingram, Bt., on Jan. 4th.

One Harpy Eagle (*Thrasaëtus harpyia*), from Venezuela, purchased on Jan. 22nd.

One Three-keeled Terrapin (*Staurotypus triporcatus*), from Guatemala, new to the Collection, received in exchange on Jan. 8th.

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On behalf of Mr. W. Simpson Cross, F.Z.S., Mr. R. I. Pocock exhibited a photograph of the very rare South-American Wild Dog

Text-fig. 15.



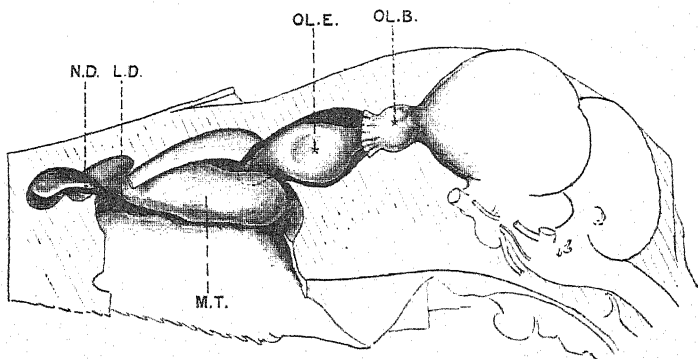
Maned Wolf (*Canis jubatus*). From life.

sometimes called the Maned Wolf (*Canis jubatus*), and laid stress upon the importance of publishing photographs of all animals

that were rarely imported alive to Europe, so that a correct idea of their true form might be conveyed to artists and taxidermists. In the present instance the value and interest of the photograph submitted to the Society by Mr. Cross might be judged by comparing it with the stuffed specimens of this Dog exhibited in museums and with the published lithographic figures of the species.

Mr. R. H. Burne, F.Z.S., exhibited a preparation \* of the head of a Sea-Lamprey (*Petromyzon marinus*), designed to show the mechanism by which water is drawn into the olfactory chamber at each inspiration and expelled at each expiration. The current of water is produced by the alternate compression and expansion of the blind bulb-like end of the nasal sac. This sac is separated from the branchial chamber by the thin compressible œsophagus only and responds to the alterations in pressure within the branchial chamber that are due to the alternate expansion and contraction of its walls during the process of respiration. The current of water entering the nostril is deflected by valves into the olfactory chamber and among the leaves of the olfactory rosette before passing into the nasal sac.

Text-fig. 16.

Section of the head of an Albatross (*Diomedea exulans*).

L.D., opening of lacrimal duct; M.T., maxillo-turbinal; N.D., opening of duct of nasal gland; OL.B., olfactory bulb; OL.E., olfactory eminence.

The action of this mechanism has been observed and recorded by Bert (Ann. Sci. Nat. sér. 5, t. vii. 1867, p. 372.)

\* No. E 85, Physiol. Series, R. College of Surgeons' Museum.



Mr. Burne also exhibited a specimen showing an aspirator contrivance of a somewhat similar character in the Sea-Bream (*Pagellus centrodonatus*)\*, by the action of which a current of water is drawn into the anterior nostril, passes over and through the olfactory rosette, and is expelled by the posterior nostril.

The mechanism consists of two accessory membranous sacs that open into the hinder end of the olfactory chamber and are so placed that in the resting state with the mouth shut they are compressed respectively by the process of the premaxilla and by the dorsal margin of the maxilla. As the mouth opens the sacs expand by the withdrawal of these bones from contact with them, but are again compressed when the mouth is shut. Similar sacs have been observed in many Acanthopterygian Fishes.

Mr. Burne also showed a section of the head of an Albatross (*Diomedea exulans*)†, in which the brain and the olfactory chamber had been exposed to show the relatively enormous development of the olfactory organ (text-fig. 16, p. 65). The olfactory bulbs measured 7 mm. in diameter, and received large nerves from the nasal septum and lateral wall of the olfactory chamber. (The rest of the cerebral hemisphere measured 30 mm. in length.) The olfactory eminence or pseudo-turbinal was also remarkably developed and lay for the most part in a special backward prolongation or recess of the general cavity of the nose. Except for the Ki-wi (*Apteryx*), this is apparently the most highly developed organ of smell recorded among birds. In this specimen the opening of the duct of the nasal gland upon the edge of the atrial pseudo-turbinal, close to the border of the nostril, was also shown.

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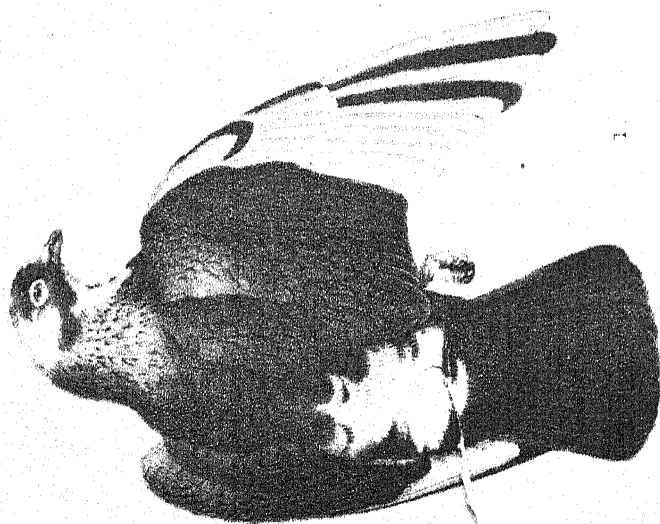
Dr. L. W. Sambon, F.Z.S., exhibited a large series of specimens of internal parasites obtained by him from animals recently living in the Society's Gardens. He laid stress on the important additions to knowledge to be derived from an adequate investigation of such material, and on the practical results to the health of the animals in the Gardens that might be expected.

\* No. E 95, Physiol. Series, R. College of Surgeons' Museum.

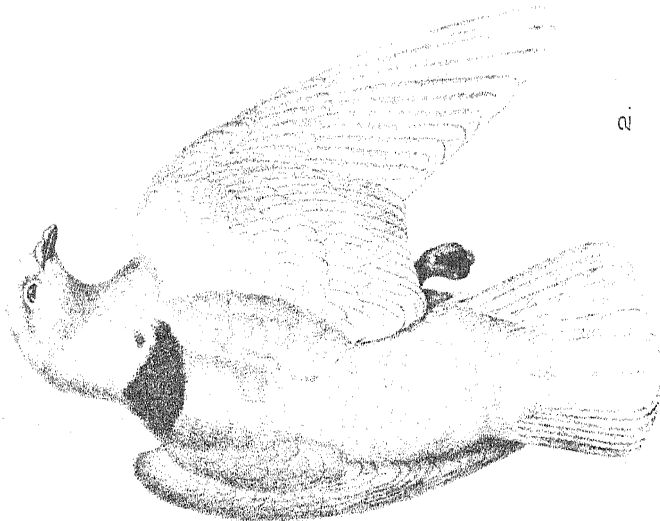
† No. E 116 a, Physiol. Series, R. College of Surgeons' Museum.

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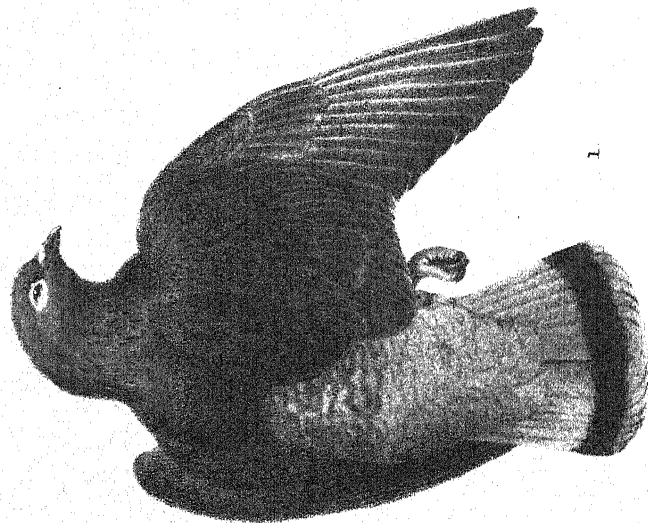
H. Goodchild del. et lith.



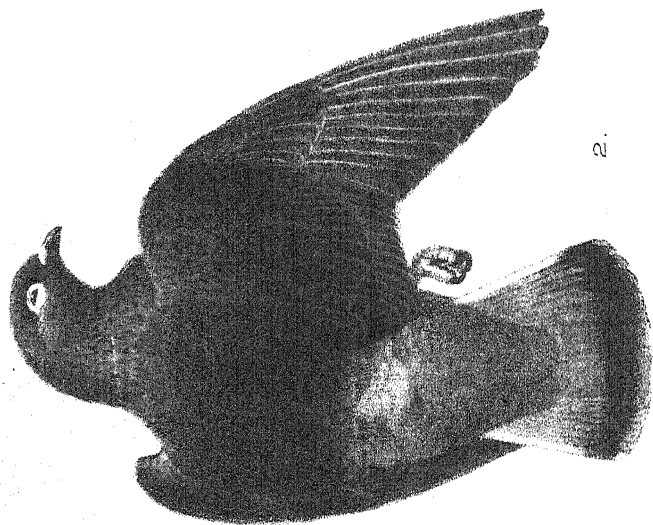
Full imp.

BARB-FANTAIL CROSS.





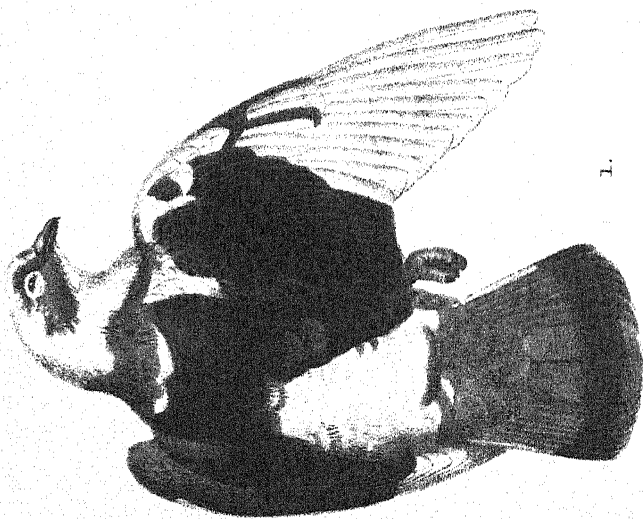
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H. Goodchild

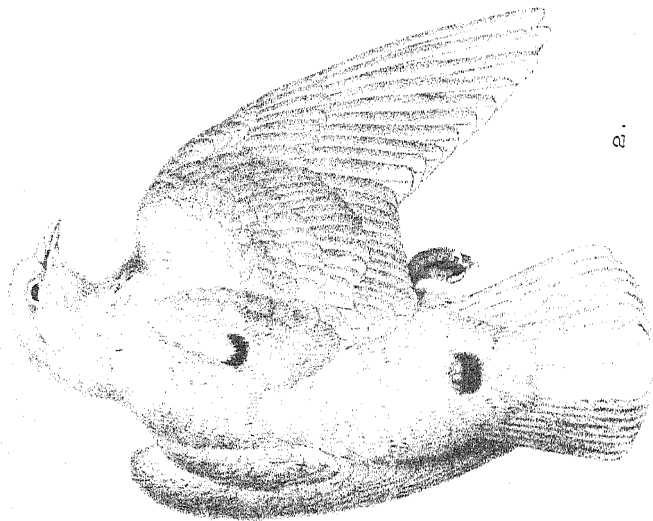
BARB-FANTAIL CROSS.





H. Goodchild del et lith.

BARE-FANTAIL CROSS.

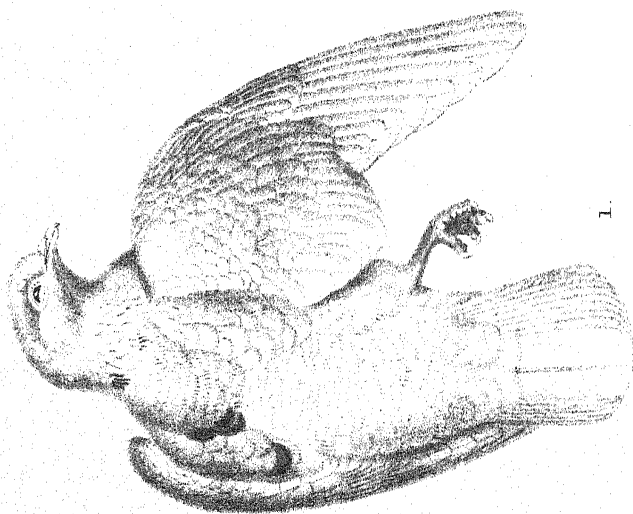


Hutch inf

TUMBLER-FANTAIL CROSS.







H. Goodchild del et lith.



Edw. W. 1908

TUMBLER-FANTAIL CROSS.

The following papers were read :—

1. On the Inheritance of Colour in Domestic Pigeons, with Special Reference to Reversion. By RICHARD STAPLES-BROWNE, M.A., F.Z.S.

[Received January 20, 1903.]

(Plates IV.-VII.\*)

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## INTRODUCTION AND BRIEF STATEMENT OF RESULTS.

Since Darwin's classical experiments on reversion, very little inquiry has been made into the inheritance of colour in Domestic Pigeons. But with the rediscovery of Mendel's work a great impetus has been given to the study of cross-breeding; and it was considered that a repetition of experiments with Pigeons, in the light of modern knowledge of the science of genetics, would prove both interesting and instructive.

The following account contains the description of certain experiments with Pigeons, begun in 1901, which, although not identical with the matings used by Darwin, are yet planned on the lines adopted by him. Most of the pure-bred varieties used are also those with which he worked.

It will be remembered that the most striking example of reversion was obtained by Darwin as follows:—He mated a black Barb to a white Fantail, and also a black Barb to a red Spot, which is a white pigeon with the tail and tail-coverts red, having, in addition, a red spot on the forehead. He then mated together the mongrel offspring obtained from these two crosses, and from this was produced a bird identical with *Columba livia* excepting

\* For explanation of the Plates, see p. 104.

that "the head was tinted with a shade of red, evidently derived from the Spot, and was of a paler blue than in the rock-pigeon, as was the stomach." (*v. Animals & Plants under Domestication*, 2nd edition, vol. i. p. 209.)

In the experiments here described, as a Spot pigeon was not readily obtainable, a black and white Nun pigeon was substituted. When the Barb-Fantail mongrels were mated to the Barb-Nun mongrels, however, no reversionary types appeared (*v. Exps. 1, 34, 37, 38, and 39*). It was, however, found that, when the Barb-Fantail crossbreds were mated together, some birds were produced having certain blue feathers. Various experiments with birds produced from the cross between the Barb and Fantail were carried out at some length, but, owing to the limitations of space, the Barb-Nun crosses were soon discontinued.

The blue colour, when it appeared, was found chiefly in the tail and neighbouring parts, as had already been observed by Darwin. Associated with this the black tail-bar was invariably present. The wing-coverts and backs of the reversionary types obtained were generally of a smoky-black colour, thus obscuring the two wing-bars found in the rock-pigeon.

The reversionary type in pigeons may in some cases be obtained in the first cross-bred generation (F.1). Such a result Darwin observed when he crossed a Nun with a red Tumbler.

The fact that in the Barb-Fantail cross the reversionary blue does not appear until F. 2, is interesting. The F.1 generation contains all the elements introduced by the parental types; nevertheless it is not reversionary in colour, but resembles the black Barb except for the addition of some white. From the fact therefore that the blue reversionary form can be produced by such F.1 birds, it is clear that they contain some element which prevents the appearance of the blue. This element is evidently the factor for black self-colour; and the experiment shows that this element is dominant, or, more strictly, epistatic, to the blue. The black factor must thus be regarded as an element not derived from the wild pigeon, but added to it by some subsequent variation. When, by recombination of the various elements, the F.2 forms are produced, those combinations which contain the blue in the absence of the black factor exhibit the blue, while those which contain the black in addition cannot exhibit it.

In some other cases of reversion on crossing (*e. g.*, Sweet Peas and Stocks), the reversion can be proved to be due to the meeting of complementary factors. In the case of the Barb-Fantail cross the evidence is not yet sufficient to show whether the factors needed to produce the atavistic condition are all present in the Barb, and their effect merely hidden by the presence of the black factor, or whether a necessary factor is introduced by the Fantail; but the fact that no blues came in the F. 2 made from F. 1 (Barb  $\times$  Fantail)  $\times$  F. 1 (Barb  $\times$  Nun) distinctly suggests that some factor of the blue did come from the Fantail.

By far the greatest number of matings here described belong to the Barb-Fantail experiment. In all 33 such matings were made. The descriptions of the pure bred birds and the several types of cross-bred birds produced are first given. The details of the various matings are then described. For the sake of clearness these are not given in the order in which they were made but are divided into three series.

Series A, comprising Exps. 1-11, deals with matings in the direct line, together with the testing of extracted whites. The results are further tabulated in Table I.

Series B (Exps. 12-26) shows the matings of crossbreds, chiefly blues, to whites, and the subsequent matings of birds derived from such crosses. Tables II. and III. deal with results in this series.

Series C (Exps. 27-33) deals with the matings of blues and blacks and the further crossings of offspring produced from such matings.

The minor characters—irides, beaks, claws, and eye-wattles—are described at the end of the paper; the details given under the descriptions of the experiments refer to plumage only.

The general results of the Barb-Fantail experiments may be briefly summarised as follows:—

The F. 1 generation shows a dominance of black to white, and the further matings show that blue is also dominant to white. This dominance of the coloured to the non-coloured type is, however, imperfect, as the majority of birds produced from the mating of black or blue with white show some white feathers, chiefly on the rump.

In the F. 2 generation the following types appear:—

Black.

Black, with some white feathers. (Black w. f.)

Blue.

Blue, with some white feathers. (Blue w. f.)

Red.

White, with some coloured feathers.

White.

The blue type may be homozygous or may be dominant to white. Black was never obtained from the mating together of two blues. The matings of blues and blacks in Series C show that blue is a simple recessive to black. The absence of white feathers in blue birds of the F. 2 generation does not necessarily indicate that they are homozygous, for Exp. 30 shows such a blue to contain white. Conversely, an F. 2 blue with some white feathers is shown in Exp. 13, when mated with a white, to produce blues with some white feathers only. The significance of the presence or absence of white feathers has not been clearly made out. It was at first thought their presence was indicative of the fact that the bird was giving off white-bearing gametes. This, however, is not

so in all cases\*. From the matings of blues with white feathers, as in Exps. 11, 24, 25, and 26, whites were produced, and a definite proportion of homozygous blues was to be expected. With one exception, however, all the blues produced from these matings showed some white feathers. We are led to conclude that some of these are probably homozygous, although the assertion cannot definitely be made without testing a large quantity of such birds, of which space did not permit. On the other hand, the matings of blues with some white feathers to whites in Series B has not revealed a homozygous bird other than that in F. 2 already mentioned.

One distinctly abnormal result occurred in Series B from the mating of blues with white feathers to whites. The proportion of whites produced was here much higher than the expected equality. This result, which is discussed later, evidently points to the existence of a definite complication.

The red birds obtained in F. 2 are only briefly mentioned in the present paper. A further series of experiments, dealing with them, is now in progress, a full report of which will be published in another communication.

The majority of reds, produced in the F. 2 generation and from subsequent matings, showed a bluish tail with a very distinct bar, the under parts also having a bluish tinge. Certain specimens have, however, been produced in which the bar is absent, and the amount of blue much reduced. It is possible, therefore, that two kinds of reds may eventually be demonstrated. In addition, red has shown itself to be recessive to both black and blue, but dominant to white†.

The extracted whites, which are shown to breed true, need no comment, with the exception of five produced in the direct line (Exps. 4, 5, and 8) in which some coloured feathers were present. These are shown in Exp. 7 to produce whites with and without coloured feathers in equal numbers. It is probable that this has

\* As Crampe and Doncaster have shown in rats, and Hurst in the case of rabbits, the presence of some white in otherwise self-coloured types, may be an indication of heterozygosis in respect of a pattern-factor, and the same possibility is to be remembered here.

† The results and figures so far obtained from the further experiments are briefly as follows:—

- |   |   |
|---|---|
| (a) F. 2 red × F. 2 red                       | gave 7 red, 1 white with few red feathers, 2 white. |
| (b) F. 2 red × F. 2 red                       | " 3 red, 3 white.                                   |
| (c) F. 2 red × F. 3 red                       | " 3 red, 1 white with few red feathers, 1 white.    |
| (d) F. 2 red × white                          | " 2 black, 8 white.                                 |
| (e) Black from (d) × white                    | " 12 white, 6 blue, 2 black, 1 red.                 |
| (f) F. 2 red × black                          | " 6 red, 4 black.                                   |
| (g) Red from (f) × red from (f)               | " 7 red.  |
| (h) F. 2 red × blue                           | " 6 black, 5 blue.                                  |
| (i) Black from (h) × black from (h) (2 pairs) | gave 10 black, 7 red, 3 blue.                       |
| (j) Blue from (h) × blue from (h)             | gave 9 blue, 2 red.                                 |

In the above no mention is made of white feathers occurring on coloured birds; they occurred, however, on a large number, and their distribution corresponded to that in similar birds described in the present paper. It will be noticed that the number of white birds produced was above the expected proportion. Exp. (f) was a brother and sister mating.

been introduced by the Fantail. It is pointed out below that one of the Fantails in the strain used (Lee ♀ 7) showed a black feather. The relation between this bird and Fantail ♂ 23, the bird used in Exp. 2, is shown in a pedigree of the Fantails. Although several pairs of pure-bred Fantails were kept, "splashed" birds never appeared in their offspring. An opportunity appears to have arisen in the crossing, however, by which this latent character was able to manifest itself.

A further series of experiments was undertaken on the crossing of two distinct white breeds, Tumblers and Fantails. Here again blue colour was produced in the F. 2 generation. An account of this cross is included in the present paper.

For testing the various Mendelian ratios the pigeon is not a thoroughly satisfactory subject to work with, unless the experiments can be carried out on a very extensive scale. To insure the desired mating it has been found necessary to keep each pair of birds in a separate aviary. The number of pairs kept is therefore limited. Further, the number of offspring produced by a pair of pigeons is comparatively small, seldom exceeding ten in any one year. In a few cases, when a ratio between the numbers of the various types of offspring produced by a cross was desired, the same mating has been continued for a second year.

In the following account the ordinary Mendelian terms are used.

#### THE BARB PIGEON. (Pigeon polonais.)

In 'Animals and Plants under Domestication,' Darwin describes the points of the Barb thus:—"Beak short, broad, deep; naked skin round the eyes broad and carunculated; skin over nostrils slightly swollen." It was hoped that these characters might be traced in the crossbreds, but some difficulty was experienced in obtaining accurate measurements, and the attempt was abandoned. The "eye-wattle" or cere, moreover, does not attain to its maximum development until the bird is in its fourth year. The Barb is a "self-" or whole-coloured pigeon, and is found in black, red, yellow, dun, and white. Of these black is the commonest. Blue Barbs are exceedingly rare, and are seldom if ever used by breeders for crossing with the other colours. No wing- or tail-bars, or chequering are found in the usual colours. The eye-wattle is bright red. The iris is generally white, sometimes orange, and in white Barbs is black. The beak and claws are desired by breeders to be white; there is, however, a tendency for black Barbs to have the beak tipped with black, or even horn-coloured beaks. This was the case with the specimens used in these experiments. Four black Barbs were obtained; those used in Exps. 1 and 34 were bought through a poultry advertising paper, and their origin is unknown. Barb ♀, No. 7, used in Exp. 2, was obtained from Mr. J. Wilkins of Swindon. This

bird was bred from blacks only for five or six generations. In the F. 2 generation from this bird crossed with a white Fantail red birds were obtained, and it is quite possible that this colour figured in the ancestry of the Barb ♀, as breeders are in the habit of crossing blacks with reds in order to obtain white beaks on the blacks. Barb ♂, No. 100, used in Exp. 27, was obtained from Mr. Edwards of Exeter. This bird is believed to have been bred from blacks for four generations, but in the preceding generation a dun ♀ was used. It will be noticed that in Exp. 27, a dun was produced.

#### THE FANTAIL PIGEON. (Trembleur.)

This variety is well-known on account of the large number of its tail-feathers; specimens having as many as 42 tail-feathers having been observed. This character has been noted in the crosses, and further experiments are still in progress. It is intended that this should be dealt with later in a separate communication. By far the largest number of Fantails are white, and only white birds have been used in these matings. Blue and silver Fantails, both having wing- and tail-bars, are bred by fanciers, as well as self-coloured blacks, reds, yellows, and duns. There are further certain birds possessing well-defined patterns of which the "saddle-back" is the best known.

It is stated by breeders that deep rich blacks are difficult to obtain, owing, no doubt, to the frequent crossing with blues. The irides of the white birds are black, those of the coloured birds either white or orange. The whites have also white beaks and claws, and flesh-coloured ceres or eye-wattles. The Fantail exhibits a curious jerking or twitching movement of the neck; this habit has been noticed in certain of the crossbreds, but no attempt has been made to trace it through the successive generations. During the experiments a small strain of white Fantails was kept, the original birds being obtained as follows:—

From Mr. J. Harrison of Belper, Derbyshire, a judge of pigeons and breeder of several varieties, 1 ♀ and 1 ♂.

From Mr. J. Lee of Ilford, Essex, 4 ♀'s and 1 ♂.

From the late Mr. J. F. Loversidge of Newark, 1 ♂.

From Mr. W. Stevenson of Beith, N.B., 1 ♂. The three latter gentlemen are well-known breeders of Fantails.

From the various matings of these birds twelve Fantails used in the crosses were raised. The appended pedigree, in which the birds used are numbered and underlined, shows their mutual relationships. Lee ♀ 7 was peculiar in the fact that at the moult following its purchase a black tail-feather made its appearance. At the various successive moults the replacing feather in that position was always black. Although several white Fantails were bred in this strain no bird was produced showing any colour in the plumage. The colours of the irides, beaks, claws, and eye-wattles were also observed to breed true.





## TYPES OF BIRDS PRODUCED IN THE BARB-FANTAIL CROSS.

The birds produced in this cross fell naturally into five classes—black, blue, dun, red, and white. Of these the black, blue, and white are chiefly dealt with in the present paper.

Coloured birds are divided into two classes; those with some white feathers in the plumage, and those without white. The white birds are similarly divided into those having some coloured feathers, and those with none.

It was possible to see to which type a bird belonged at an early age.

The descriptions of the types which follow include the more striking variations noticed in individuals.

1. *Blacks.*

The blacks produced in these crosses were generally of a rich deep colour similar in all respects to that found in the Barb. They possessed the green and purple iridescence on the neck which is commonly seen in all dark types of domestic pigeons. There were, however, certain birds produced, which are specially noted in Exps. 27 and 32, bred from the mating of black and blue, which were of a smoky or sooty black colour. In some of these birds wing-bars of a darker shade of black were observed. The tail-bar was observed on one specimen only.

2. *Blues.*

The birds classed as blue in the following experiments were not identical with *Columba livia*, as were the birds, produced by Darwin, referred to in the introduction. Their general colour was a smoky black with blue tail and black tail-bar. Laying aside the details of the distribution of white when present, which is dealt with below, the series of blue birds produced was very uniform in type. Slight variations occurred in the shade of the blue colour, and the substitution of chequered feathers (*i. e.* blue feathers edged with a variable amount of black) for the smoky black of the wing-coverts. These points were not very distinctive: they are, however, noted under the experiments in which they occurred. The head and upper part of the neck were generally bluish, slightly darker than in *C. livia*, but varying to a smoky black. The lower part of the neck, upper part of the back, wings, and upper part of the breast smoky black. The wing-bars were generally obscured, but in some specimens could be distinguished. The lower part of the breast, lower part of the back and abdomen were blue, occasionally with slight chequering.

The rump was blue, sometimes of a lighter shade than that in other parts of the body. The flanks, thighs, vent, upper and under tail-coverts were blue. The tail-feathers were blue with a black bar, which was sometimes terminal, but more usually a

short distance from the end of the tail. There was frequently, but not invariably, a white edging to the outer tail-feathers.

*"Kitiness."*

This term is used by breeders to express a rustiness or bronzing of the black feathers. It gives to a black feather the appearance of being edged with a reddish tinge. In certain breeds of pigeons, notably the Jacobin, this characteristic persists through life in some individuals. In the majority of cases, however, it is lost either before or at the first moult. In the cross-bred birds produced in these experiments kitiness was observed in many of the young birds. It appeared not only on the blacks but also on the smoky-black parts of the plumage of birds classed as blues. In the case of every bird that was allowed to reach maturity the kitiness disappeared, except in cases where it was present on the flight-feathers. In this situation it was noticed to persist through life. There is, at present, no reason to suppose that kitiness influences inheritance of colour.

*3. Blacks and Blues with some white feathers.*

It is convenient to describe these two types together. They differ from the two preceding types only in being more or less mottled with white. The amount of white varies very greatly. The black colour has never been observed to be of the sooty shade, but always deep as in the Barb. The amount of white present appears to increase with the number of generations from the original cross. With very few exceptions colour has been in excess of white in these birds. The white is found in certain fairly well-defined areas, of which the following is a list arranged roughly in the order of frequency of occurrence.

1. Rump, vent, and thighs.
2. Certain areas on the head, noticeably the occiput and post-orbital regions. The neck. The lower part of the abdomen. Carpal joints. The bastard wings.
3. Primary flight-feathers generally commencing with the most external, and tertiaries immediately over them. Tail-feathers generally commencing with those near the middle, and both upper and upper tail-coverts.
4. Breast, wing-coverts, and scapulars.

Bonhote has shown in the Journ. Linn. Soc. vol. xxix. p. 185, that the presence or absence of colour tends to make its appearance in mammals and birds in certain definite areas, which he has named "*pæcilomeres*," and of which he gives a list in the Proceedings of the IVth International Ornithological Congress. It will be noticed that the positions of the white in these pigeons agree closely with Bonhote's observations.

In the descriptions of the results of matings details of the various markings are given.

#### 4. *Duns.*

One bird of this type was obtained in Exp. 27. The head, neck, back, rump, breast, abdomen and under parts were of a uniform dark dun colour. The wing-coverts were edged with a lighter shade. Wing-bars could not be distinguished. The flight-feathers were lighter than the rest of the plumage. The tail-feathers showed a bar of a darker shade which was conspicuous on handling the bird.

#### 5. *Reds.*

Five red birds were obtained in F. 2 from Experiment 4. The shade varied slightly in the different individuals, in some the colour being much darker than in others. In all the rump, tail-feathers, and both upper and under tail-coverts presented a bluish tinge. This, however, differed in the various specimens. In some there was merely a bluish-red appearance on the rump and tail, in which case the tail-bar appeared to be merely an aggregation of pigment; whilst in others the rump and tail were almost of the same colour as that already described on the "blue" birds. In these latter the tail-bar was well defined and appeared to be of a reddish-yellow colour. White feathers were present in varying amount on all the red birds. The distribution of the white corresponded with that already described for blacks and blues.

#### 6. *Whites.*

The majority of whites produced in these experiments showed no signs of coloured feathers. A few, however, were raised which had a few ticks of colour on the neck or rump. These were either black or red. Full details are given of these birds in the descriptions of the matings from which they were produced.

### DETAILS OF THE SEVERAL MATINGS.

#### Series A.

##### F. 1 *Generation.*

EXP. 1.—White Fantail ♀ 19 × Black Barb ♂, no number.  
Five young birds raised.

EXP. 2.—Black Barb ♀ 7 × White Fantail ♂ 23. Four young birds raised.

The colour of the F. 1 generation raised from the two above experiments was practically uniform. The birds were black with a few white feathers which usually appeared on the rump, vent, and thighs. In only one instance was there any approach to mottling, and in this bird the black was greatly in excess of the white. Birds raised in the two reciprocal experiments were indistinguishable.

Three matings of the F. 1 birds were made, the results of which are shown in Table I. Thirty-four birds of the F. 2 generation were raised.

TABLE I.

Exp. No.	♀	Origin from Exp.	Also used in Exp.	♂	Origin from Exp.	Also used in Exp.	OFFSPRING.					
							Black. w. f.	Blue. w. f.	Blue Red.	White with some coloured feathers.		
1.	White Fantail.....	19	—	Black Barb (no number).	—	—	—	—	—	—	—	
2.	Black Barb .....	7	—	White Fantail .....	23	—	—	—	—	—	—	
3.	F. 1 Black with some white.	63	1	F. 1 Black with some white.	71	{ 5, 12 & 39 }	—	2	1	—	1	
4.	F. 1 Black with some white.	59	2	F. 1 Black with some white.	62	—	4	6	—	5	3	
5.	F. 1 Black with some white.	63	1	F. 1 Black with some white.	60	{ 3, 12 & 39 }	1	4	—	—	2	
6.	F. 2 White .....	53	3	White Fantail .....	9	42	—	—	—	—	4	
7.	F. 2 White with few black.	56	5	F. 2 White with black patch.	5	—	—	—	—	—	5	
8.	F. 2 Black with some white.	106	5	F. 2 Black with some white.	6	31	2	6	—	3	2	
9.	F. 2 Blue with some white.	51	3	F. 2 Blue .....	1	16	—	—	3	6	—	
10.	F. 3 Blue .....	97	9	F. 3 Blue with some white.	51	28	—	—	4	2	—	
11.	F. 3 Blue with some white.	52	9	F. 3 Blue with some white.	13	—	—	—	—	9	2	
12.	F. 1 Black with some white.	63	1	White Fantail.....	32	{ 3, 5 & 39 }	—	2	—	—	—	

F. 2 *Generation.*

As will be seen by the Table no black birds were raised in Exp. 3. This experiment came to an untimely conclusion early in the breeding season owing to the accidental death of the ♂. No other ♂ raised in Exp. 1 was then living. It seems likely, however, that if the mating could have been continued black birds would have appeared. Exp. 4 was continued for two years, and, in addition to the birds included in the table, a young bird was hatched which died in the nest at the age of ten days. It was dark in colour, but whether it would eventually have been black or blue could not at that age be distinguished.

*Black birds* in the F. 2 generation.—Of the fifteen black birds raised five showed no trace of white, the other ten having some white feathers. Birds entirely black were not tested at this point of the experiment, but in the crosses between Barbs, Fantails, and Nun pigeons it was shown that extracted blacks in F. 2 bred true (*v.* Exps. 40 & 41). Those having white feathers were noticed to show more white than the birds of the F. 1 generation. In addition to having white feathers on the same parts of the body as the preceding generation, these birds frequently showed white on the head and throat, also on the wings, and more especially on the flight-feathers. The black, however, always greatly predominated in the plumage. In one case there were only a very few white feathers on one thigh.

*Blue birds* in the F. 2 generation.—In addition to the general description of the blue birds already given, it may here be stated that the bird bred in Exp. 5 (No. 19) differed from those in Exp. 3 in having the blue colour much darker. In the young raised from the subsequent matings of the offspring of this bird, the dark blue colour was very marked, so that it was possible to pick them out at sight in an aviary containing many blue birds. This bird showed two white feathers on the rump which were afterwards moulted out. Experiment, however, proved that it did not contain white (*v.* Exp. 13). Of the blue birds raised in Exp. 3 two (Nos. 1 & 14) showed no white, while the third (No. 51) had a few white feathers at the vent. Further matings proved that two of these birds contained white recessive, while the other did not (see Exps. 9, 16, & 30). Of the four F. 2 blues, therefore, two were homozygous to that colour.

*Red birds* in the F. 2 generation.—A general description of these birds has already been given. It seems desirable to postpone all further details until the investigation is more advanced.

*White birds* in the F. 2 generation.—Of the ten extracted white birds six showed no coloured feathers, and four showed a little colour. From Exp. 4 two birds with coloured feathers were raised. Of these one (No. 1) showed four or five feathers of a brownish or reddish tinge on the neck, these were afterwards moulted out. The other (No. 15) had the head and throat ticked with some reddish feathers. These birds were not bred from. In Exp. 5 one white bird (No. 5) was produced which

showed a large patch of black feathers about the size of a five-shilling piece at the root of the neck. Another (No. 56) raised in the same experiment had a few feathers on the rump edged with black. These two birds were mated together in Exp. 7.

*Testing the extracted Whites in F. 2.*

At the time it was considered desirable to test the extracted whites only one was available, viz. that bred in Exp. 3. It was, therefore, mated to a white Fantail.

Exp. 6.—Extracted White ♀ 53 × White Fantail ♂ 9.

Four young were produced, all white with no coloured feathers.

Exp. 7.—White birds with coloured feathers raised in Exp. 5 described above were mated together.

White with black feathers ♀ 56 × White with black patch ♂ 5.

Ten young were raised in this experiment, of which five showed no coloured feathers; one had one black feather on the rump which was afterwards moulted out; two had two feathers on the rump edged with black; and the remaining two had four and five feathers respectively similarly edged with black.

*F. 3 Generation.*

A pair of black birds with some white feathers of the F. 2 generation raised in Exp. 5 were mated together in 1905, and the experiment was repeated in 1907. In the intervening year the birds were used for mating with blues in Exps. 28 & 31.

Exp. 8.—F. 2 Black w. f. ♀ 106 × F. 2 Black w. f. ♂ 6.

This mating gave 2 blacks, 6 blacks with some white feathers, 3 blues with some white feathers, 1 white with some coloured feathers, and 2 whites. Of the blacks with some white feathers, one bird had only one white feather on the rump, another had two white feathers on the thighs and three of the under tail-coverts tipped with white. The remainder had white on the head, neck, rump, vent, thighs, and under tail-coverts; but one bird had in addition 12 white flights, and 11 white tertiaries, while another had some white flights and tertiaries and also 4 white tail-feathers. Of the blues with white feathers, one bird had white on the rump only, the other two having white on the head, neck, rump, vent, and thighs, one of them having in addition three white flights and two white tertiaries. The bird described as white with some coloured feathers had three feathers on the rump tipped with black.

Exp. 9.—F. 2 Blue few white feathers ♀ 51 × F. 2 blue ♂ 1.  
These birds were raised in Exp. 3.

Nine offspring were reared from this mating, of which three were blue with no white. The six others all showed white feathers, four of them having white on the head and throat, vent, thighs, &c., and some flight-feathers up to the number of ten as

well as two or three tail-feathers and some under tail-coverts. One bird had only two white tail-feathers and some white on the vent. Another (No. 51 F. 3) had only a very few white feathers at the vent. This bird, however, when mated to a blue without white (*v.* Exp. 10) produced young with white feathers. (The matings of these several young are shown in Exps. 10, 11, 14, 15, 17, 18, 21, 27, 28, and 31.)

#### F. 4 Generation.

EXP. 10.—F. 3 Blue ♀ 97 × F. 3 Blue with very few white feathers ♂ 51.

These birds were raised in Exp. 9. Four young were reared from this cross, of which three showed no white feathers, and the fourth had one white flight-feather, and a large patch of white on the vent and left thigh. In addition to these, two young birds were hatched but died at the age of 10 days: on one of these white quills were seen on the abdomen, but on the other no white quills were visible. From the above it appears that the ♀ bird was homozygous in respect of the blue colour, but that the ♂ contained white. Unfortunately the three F. 3 birds which showed no white were all ♀'s.

EXP. 11.—F. 3 Blue w. f. ♀ 52 × F. 3 blue w. f. ♂ 13.

In this experiment two of the birds with white feathers raised in Exp. 9 were mated together. Eleven young were raised, of which 9 were blue with white feathers and 2 were white. Of the blues with white feathers six showed much white; the white being in the same situations as in the F. 3 birds but more extensive. There was much white on the head and neck, the back and breast were in some cases mottled. The flight-feathers were mostly white up to the number of 29, and many tail-feathers up to 18, and several under tail-coverts. The whole appearance presented was a blue bird mottled with white. The other three blues, however, had only a few white feathers.

No. 15, F. 4, had only a few white feathers on the head and a small patch on the abdomen and vent. This bird, however, was subsequently proved to contain white (see Exps. 19 and 22).

No. 22, F. 4, had a small patch on the vent and thighs, two white tail-feathers, and a few under tail-coverts.

No. 76, F. 4, had a small streak of white behind the eyes, and two white feathers at the vent.

It will be noticed that no blues without white were raised in this experiment as was anticipated. This result may be compared with those of Exps. 24, 25, and 26, in which birds raised from the matings of the heterozygotes with whites did not produce the expected number of blues without white when mated together. Matings in the direct line have not been carried beyond this generation.

## Series B.

## THE CROSSBREDS MATED TO WHITES.

F. 1  $\times$  white.Exp. 12.—F. 1 Black w. f. ♀ 63  $\times$  White Fantail ♂ 32.

The ♀ 63 was raised in Exp. 1 and is the same bird used in Exps. 3, 5, and 39. In this experiment only two young were raised, both black with white feathers. One (46) had only a few white feathers on the rump, vent, and thighs; the other (47) had in addition to this a few on the head and neck and a few wing- and tail-feathers white. Had this experiment been continued whites would undoubtedly have appeared.

*Blues of F. 2, F. 3, and F. 4 mated to whites.*

Experiments 13 to 23 (see Table II.) show the results of mating the blue birds raised in the foregoing experiments to whites. Some of the whites used were pure Fantails, but the results were apparently the same when "extracted" whites were used (Exps. 19, 20, 21, 22).

Exps. 13, 14, and 15 show the result of mating homozygous blues with whites—24 young were raised in these three experiments, all blue with some white feathers.

Exps. 16–23 show the results of mating blues containing white to whites. In all 41 young were raised, of which 13 were blue with white feathers and 28 were white. The expected results from these matings were blues (with white feathers) and whites in equal numbers. The irregular numbers are discussed in detail immediately after the descriptions of the experiments from which they were obtained.

*Details of Exps. 13–23.*Exp. 13.—White Fantail ♀ 25  $\times$  F. 2 Blue (with 2 white feathers) ♂ 19.

The ♂ has already been described among the blue birds of the F. 2 generation as being of a darker colour than usual, and having two white feathers which were subsequently moulted out. Twelve offspring were reared all blue with some white feathers. The blue colour varied slightly, in some it was of a darker shade than in the father, and in all was darker than in birds raised in the other experiments. The amount of white also varied from a bird having only a few white feathers on the rump, vent, and thighs, to one having white on the head, neck, breast, rump, abdomen, vent, and thighs, as well as several wing-feathers, 10 tail-feathers, and some under tail-coverts. The average amount of white was about midway between these two extremes.

Exp. 14.—F. 3 Blue ♀ 98  $\times$  White Fantail ♂ 46.Exp. 15.—F. 2 Blue ♀ 120  $\times$  White Fantail ♂ 26.

The two ♀ birds were raised in Exp. 9. No white feathers were seen. Twelve offspring were raised all blue with white feathers. The blue colour was uniform throughout. In some cases the sooty colour of the wing-coverts was to a slight extent



TABLE II.

Exp. No.	♀	Origin from Exp.	Also used in Exp.	♂	Origin from Exp.	Also used in Exp.	OFFSPRING.	
							Blue w. f.	White.
13.	White Fantail .....	25	—	F. 2 Blue with some white.....	19	—	12	—
14.	F. 3 Blue .....	98	9	White Fantail .....	46	—	8	—
15.	F. 3 Blue .....	120	9	White Fantail .....	26	—	4	—
16.	F. 2 Blue with some white.....	51	3	White Fantail .....	2	—	2	4
17.	White Fantail .....	40	—	F. 3 Blue with some white.....	30	—	2	4
18.	F. 3 Blue with some white.....	14	9	White Fantail .....	44	—	2	7
19.	F. 4 Blue with some white.....	15	11	Extracted white .....	50	See text.	1	2
20.	F. 4 Blue with some white.....	9	10	Extracted white .....	50	„	1	2
21.	Extracted white .....	20	31	F. 3 Blue with some white.....	13	9	3	3
22.	F. 4 Blue with some white.....	15	11	Extracted white .....	50	See text.	1	5
23.	F. 4 Blue with some white.....	9	10	White Fantail .....	34	—	1	1

replaced by blue chequered with black. In these cases indication of black wing-bars were seen. The amount of white varied, but was in excess of the amount present in the F. 3 blues with white feathers. The birds were distinctly mottled, and in some cases the amount of white was in excess of the blue. It appeared on the head and neck, the rump, abdomen, vent, and thighs—most of the flight-feathers were white and several of the tail-feathers and under tail-coverts.

Exp. 16.—F. 2 Blue with few white feathers ♀ 51 × White Fantail ♂ 2.

The ♀ was raised in Exp. 3. The result of the mating was 4 whites and 2 blues with white feathers. Of these one (No. 13) had white on the head, rump, vent, and thighs, 6 white flight-feathers and some other wing-feathers. The other (No. 36) had white on the head, throat, rump, vent, and under tail-coverts, 16 white flights and some other wing-feathers, and 5 white tail-feathers. These two birds were mated together in Exp. 26.

Exp. 17.—White Fantail ♀ 40 × F. 3 Blue w. f. ♂ 30.

Exp. 18.—F. 3 Blue w. f. ♀ 14 × White Fantail ♂ 44.

The two blues with white feathers were raised in Exp. 9. Fifteen young were produced from these two experiments, of which eleven were white and four blue with white feathers. The amount and distribution of white corresponded roughly to the description given of similar birds in Exps. 14 and 15.

Exp. 19.—F. 4 Blue w. f. ♀ 15 × F. 3 Extracted white ♂ 50.

Exp. 20. F. 4 Blue w. f. ♀ 9 × F. 3 as above ♂ 50.

♀ 15 was raised in Exp. 11. ♀ 9 in Exp. 10. The same ♂ 50 was used in the two experiments. This bird was bred from an F. 2 Red and a white Fantail, which mating is not described in the present paper. The result of the two experiments was 4 whites and 2 blues with white feathers. These birds were similar to those bred in Exps. 14, 15, 17, and 18.

Exp. 21.—Extracted white ♀ 20 × F. 3 Blue w. f. ♂ 13.

Exp. 22.—Repetition of Exp. 19.

Exp. 23.—F. 4 Blue w. f. ♀ 9 × White Fantail ♂ 34.

The white ♀ 20 was raised in Exp. 31 from a blue and a black, both containing white. F. 3 ♂ 13 was raised in Exp. 9 and is the same bird that is used in Exp. 11. F. 4 ♀ 9 is the same bird as used in Exp. 20. These three pairs were put up to test further the proportion of blues with white feathers to whites. The young birds were killed as soon as they had feathered sufficiently for their colour to be seen. No details were kept. The blue with some white feathers in Exp. 22 died in the shell a day or two before it would have hatched. No hesitation, however, is felt in recording this bird as blue since it had a black beak. It was found that, although blue birds with white feathers sometimes occur with white beaks, no case has been met with in which white birds had black beaks. In addition to this it was noticed, as the experimenter became more familiar with the appearance of young birds in the nest, that birds which were subsequently coloured

had a darker down than those which became white. In Exp. 23 only two birds were raised; eight other eggs were laid, but proved unfertile. Exps. 21 and 23 produced blues with some white feathers and whites in equal numbers; on the other hand, Exp. 22 produced 1 blue and 5 whites. The result of the three experiments being 5 blues to 9 whites. It may further be noted that when Exp. 22, which is a repetition of Exp. 19, is reckoned with Exp. 19, we get a result of 2 blues to 7 whites, the exact figures found in Exp. 18.

#### DISCUSSION OF ABERRANT RESULTS IN EXPS. 16—23.

The expected result from these matings ( $DR \times R$ ) was an equal number of blues (with white feathers) and whites. The result obtained, however, was 13 blues to 28 whites. It is therefore necessary to analyse the results more closely. The only matings which gave equality were 21 and 23, these gave 3:3 and 1:1 respectively. The ratio 2:4 was obtained in Exps. 16 and 17, and 1:2 in Exp. 20. Seeing that the total number of birds produced in each family was small, the divergence of these ratios from the expected equality would not suggest any very marked irregularity. The totals, however, would point to the need for repetition of the experiments with greater numbers. But when we obtain the unlooked for result of 2:7 from Exp. 18 and from the birds mated together in Exps. 19 and 22, we are forced to conclude that some definite disturbing factor is present. The following questions suggest themselves. Do the results obtained from reciprocal matings differ? Has the fact of the white parent being a pure Fantail or an "extracted" any bearing on the matter? With regard to the reciprocal matings, only two matings were made (Exps. 17 and 21) in which the  $\sigma$  was blue. These gave ratios of 2:4 and 3:3 respectively. Dividing up our totals according to the nature of the matings, we arrive at the following figures:—When the  $\sigma$  was white the offspring produced were 8 blues and 21 whites. When the  $\sigma$  was blue the offspring produced were 5 blues and 7 whites. It will be noticed that, although the whites are in excess in both cases, the divergence is much more marked when the  $\sigma$  was white. The possibility of this having some influence on the proportions of the offspring cannot at present be disregarded. The behaviour of the pure Fantail and the extracted White appears to be identical. Only two extracteds were used: one of these in Exp. 21 gave a ratio of 3:3, the other in the mating used in Exps. 19 and 22 gave 2:7, and the same bird mated to another blue  $\sigma$  in Exp. 20 gave 1:2.

In connection with the excess of white offspring when the  $\sigma$  was white, it is perhaps worth recalling that in certain remarkable instances recessive forms appear in F.1 when a recessive  $\sigma$  is used. The best ascertained example of this phenomenon occurs in the Canary. Cinnamon (*i.e.* pink-eyed)  $\sigma \times$  green (*i.e.* black-eyed)  $\sigma$  gives F.1 all black-eyed; but black-eyed  $\sigma \times$  pink-eyed  $\sigma$  may produce some pink-eyed birds, which are said to be always

females. Professor Whitman also informed Mr. Bateson that in certain of his crosses between species of Doves white females may be produced when the father is white, though the reciprocal cross gives all coloured birds.

Unfortunately no sufficient record of the sexes produced in the cases of the Barb-Fantail Crossbred birds was made; and in order to establish a comparison with these other cases, it would be necessary to show that among the whites here produced there was an excess of females.

*Results of mating together Blue birds with white feathers, raised in Exps. 13 and 16 respectively. (See Table III.)*

Exp. 24.—Blue w. f. ♀ 5 × Blue w. f. ♂ 4.

Exp. 25.—Blue w. f. ♀ 10 × Blue w. f. ♂ 11.

These four birds were raised in Exp. 13. The results of the matings were 6 blues with white feathers and 2 whites. No blue birds without white feathers were raised (*cf.* Exp. 11). One of the birds (48), however, had only a few white feathers on the rump, vent, and thighs; and another (17) had white in the same position with a few under tail-coverts. The bird having the maximum development of white (55) showed a few white feathers on the head, neck, rump, vent, and a little mottling on the breast, 4 white flights, 4 white tail-feathers, and a few under tail-coverts and other wing-coverts. The amount of white in this bird is not so much as in the bird showing the maximum development of white in Exp. 13. In addition to the birds included in the Table a bird was hatched in Exp. 24 which died in the nest when very young. It was of a distinct reddish tinge with some white feathers, having tail and flights "blackish." It is probable that this was "kitiness" (*v. ante*), and the bird would have eventually been blue with white. Only two birds were raised from Exp. 25. These were blue with some white feathers. There is no doubt however that, had the mating been continued, white birds would have appeared as in Exp. 25.

TABLE III.

Exp. No.	♀	Origin from Exp.	♂	Origin from Exp.	OFFSPRING.		
					Blue.	Blue w. f.	White.
24.	Blue with some white } 5	13	Blue with some white } 4	13	—	4	2
25.	Blue with some white } 10	13	Blue with some white } 11	13	—	2	—
26.	Blue with some white } 36	16	Blue with some white } 13	16	1	5	4

Exp. 26.—Blue w. f. ♀ 36 × Blue w. f. ♂ 13. Both these birds were raised in Exp. 16.

Of the offspring 4 were white. One (69) was the blue form without any white feathers. This is the *only* blue bird without white feathers raised from the mating of two blues with white. Five were blue with white feathers, and of these one (75) had only 4 white feathers on the head, a very few on the thighs, and a few white under tail-coverts. Another (78) had a few on the rump, vent, and thighs, and some under tail-coverts. The other three showed more white than those described in Exps. 24 & 25; one of them having 12 and another 11 white flights as well as some white wing-feathers over them, whilst the third had 17 out of 21 tail-feathers white, in addition to the white on the head, neck, rump, vent, thighs, and under tail-coverts.

### Series C.

#### BLUES MATED TO BLACKS.

Four different kinds of matings were made of blues and blacks. Birds which did not contain white and also those in which white was carried were used. For results of the matings see Table IV.

#### *Details of Exps. 27—31.*

Exp. 27.—F. 3 Blue ♀ 98 × Black Barb ♂ 100.

The ♀ had no white feathers, and had previously been shown not to contain white (*v.* Exp. 14). The ♂ was received from Mr. Edwards of Exeter, who said that he believed it to have been bred from blacks for four generations and before that from a dun ♀. The result of the mating was 8 blacks and 1 dun. No white feathers were seen on any of the young birds. Very slight indications of wing-bars were noticeable on some of the blacks, the ground-colour being rather more sooty or smoky than in the birds previously described, and so causing the bars to stand out as a dead black. These bars were much more conspicuous in the next generation (*v.* Exp. 32). In the Dun (*v. ante*) the tail-bar was very obvious, being of a much darker shade than the ground-colour. This bird was not bred from.

Exp. 28.—F. 3 Blue ♀ 97 × F. 3 Black w. f. ♂ 6.

The ♀ 97 had no white feathers, and as already shown in Exp. 10, when mated to a blue with white feathers gave blues and blues with white feathers only.

The ♂ 6 had white feathers, and has been shown (Exp. 8) to contain white.

The result gave 9 young, of which 5 were black and 4 blue. Of the blacks three had some white feathers and two had not, and of the blues two had white feathers and two had not. One of the blues with white feathers died when a fortnight old, and only one white feather could then be seen. The amount of white in the birds showing this character varied very considerably.

TABLE IV.

Exp. No.	♀	Origin from Exp.	Also used in Exp.	♂	Origin from Exp.	Also used in Exp.	OFFSPRING.				
							Black. w. f.	Blue. w. f.	Blue. w. f.	Dun. White	White
27.	F. 3 Blue .....	98	9	14	Black Barb .....	100	—	—	—	—	—
28.	F. 3 Blue .....	97	9	10	F. 2 Black with some white ...	6	8	2	2	—	—
29.	F. 4 Blue with some white ...	15	11	{ <sup>19</sup> & <sup>22</sup>	F. 3 Black .....	109	—	2	4	—	—
30.	F. 2 Blue .....	14	3	—	Black with some white .....	46	—	1	4	2	3
31.	F. 2 Black with some white ...	106	5	8	F. 3 Blue with some white ...	13	11 & 21	1	1	1	4
32.	Black .....	12	27	—	Black .....	1	7	—	1	—	—
33.	Blue (chequered) .....	99	30	—	Blue (chequered) w. some white	16	—	4	2	—	—

Exp. 29.—F. 4 Blue w. f. ♀ 15 × F. 3 Black ♂ 109.

The ♀ 15 was raised in Exp. 11, and had previously been shown to contain white (v. Exps. 19 & 22).

The ♂ 109, raised in Exp. 8, was black with no white. This bird had not been previously bred from, but seeing that no whites were produced in this experiment we may conclude that it did not contain white.

The result of the mating gave 8 young, of which 4 were black and 4 blue. Of the blacks two (Nos. 50 & 65) showed very few white feathers at the vent. No white was seen anywhere else on the plumage. Another black bird (No. 49) was rather light or sooty in colour, as already described in Exp. 27, and very slight indications of a tail-bar were noticed. None of the blue birds showed any white.

Exp. 30.—F. 2 Blue ♀ 14 × Black w. f. ♂ 46.

Exp. 31.—F. 2 Black w. f. ♀ 106 × F. 3 Blue w. f. ♂ 13.

The ♀ 14 was raised in Exp. 3. The ♂ 46 was raised in Exp. 12 from F. 1 × white. Neither of these birds had been previously bred from. This experiment, however, showed that they both contained white.

The ♀ 106 was raised in Exp. 5, and has been shown in Exp. 8 to contain white. The ♂ 13 was raised in Exp. 9, and was shown in Exp. 11 to contain white. The total result of the two matings was 2 Blacks, 5 Blues, 3 Blues with white feathers, and 7 Whites. The blues from both matings were lighter in colour than in the preceding experiments, the sooty colour of the wings being of a much bluer shade than in the typical blue, and in some cases being replaced by blue chequered with black. The wing-bars were very distinct. Where white feathers were present they were very few in number and were confined to the rump, vent, and thighs.

*Results of mating together Blacks from Exp. 27 and Blues from Exp. 30 respectively.*

Exp. 32.—Black ♀ 12 × Black ♂ 1.

These two birds were raised in Exp. 27, and both were without any white feathers. The plumage of both was somewhat smoky, and slight traces of wing-bars could be discerned. From this mating 12 birds were hatched. Of these, however, 4 died under the age of one week. The colour of the plumage could not be ascertained. The 8 birds reared consisted of 7 blacks and 1 blue. Of the blacks, one is of a deep rich plumage showing no traces of bars. Four are of a sooty-black colour with the wing-bars very distinct. In one of these a tail-bar is also seen. The remainder are sooty-black with no, or very slight, indications of bars. It is most probable that, if these birds were bred from, the sooty-coloured specimens with wing-bars would be shown to contain blue, whilst the deep black with no traces of wing-bars would prove to be homozygous.

EXP. 33.—Blue chequered black ♀ 99 × Blue chequered black with few white feathers ♂ 16.

These two birds raised in Exp. 30 were selected as showing the lightest type with chequering. The wing-bars were very distinct. ♂ 16 had a few white feathers at the vent.

The mating produced six birds all of the chequered type with clearly defined wing-bars. Of these four showed no white, and the other two had a very few white feathers.

#### BARB-NUN CROSS.

In this cross three matings only were made, and twenty-eight young produced. The experiment was originally started, as stated in the introduction, in order to cross the F.1 Barb-Nun generation with the F.1 Barb-Fantail. Some further matings were, however, made in order to investigate the inheritance of the "shell" (*v. infra*), the results of which, together with some other crosses in experiments on the same character, are described in P.Z.S. 1905, vol. ii. p. 550. The Black Barb ♂ used in this mating was obtained through the medium of a Poultry advertising paper, and no details of its pedigree were obtainable. This bird had white irides, the beak white tipped with black, the claws white, the eye-wattles bright red.

#### THE NUN PIGEON. (Pigeon Coquille Hollandais.)

A curious structural character presented by this bird is the "shell," which is a tuft of reversed feathers standing up at the back of the head, having an appearance somewhat like that of a cockle-shell. After this point, attention is paid by breeders to its colour and markings. It is a white bird with certain coloured markings forming a very definite pattern. The markings are found in several colours, of which black, blue, dun, red, and yellow are the chief. By far the greatest number are black, and this was the colour of the ♀ used in these experiments. The head, as far back as the "shell," is black, but the coloured feathers do not extend into the shell. The chin and throat are black, forming what is known as the "bib." Ten outer flight-feathers on each wing should be black; in the specimen used, however, there were only seven black flights in one wing and eight in the other. There were also two black secondaries and two black tertiaries, as well as a few black feathers at the carpal joints. The tail is black, as also are the upper and under tail-coverts. These markings should be very definite or "clean cut," and there should be no black on any other part of the plumage. The ♀ used, however, had two black feathers on the back. The black in the bird used was not a deep rich colour, as is found in the Barb; and it is stated by breeders that many Black Nuns are found whose colour is rather smoky. This was noticed in some of the offspring of the cross. The irides are white, and there appears to be no difficulty in breeding this character true in this



variety of pigeon. In the Black Nun the cere or eye-wattle is blackish as are also the beak and claws. No details of the ancestry of the ♀ Nun were obtained. The variety breeds true to the markings and no self-coloured birds or whites are produced.

#### CROSS-BRED BIRDS.

Although this experiment was taken as far as the F. 2 generation, no blue birds were produced. The numbers, however, are small, and it is possible that in further matings they might have appeared. Blacks were raised in F. 2, but for want of space were not tested. Three birds also appeared in F. 2 which resembled the Nun in markings, these are alluded to in Table V. as "white with a few black feathers." These birds were not bred from. The remaining birds were classed in three divisions as, "blacks with a few white feathers," "mottled, with black in excess," and "mottled, with white in excess." This classification, although useful for purposes of description, is purely arbitrary, and no suggestion is made that the birds differed gametically. It was very noticeable that in the mottled birds the markings of the Nun were present, and in addition black mottling occurred on those parts of the plumage which are white in the Nun. Full descriptions of the cross-bred birds are given in the details of the experiments. There appears to be no correlation between the presence of a shell and the Nun markings.

#### *Details of the Matings.*

##### F. 1 Generation.

EXP. 34.—Nun ♀ (no number) × Black Barb ♂ (no number).

These birds were mated together for two years and twelve young were produced. All were black with white feathers and in all the black was in excess of the white. Two distinct types of birds, however, were produced. One class consisted of black birds with a few white feathers which appeared usually on the rump, vent, and thighs, and on the neck or breast sometimes in the position of the junction of the white of the breast with the black of the "bib," as described in the Nun pigeon. Seven of the F. 1 birds were of this type. In the other class, of which there were five, the birds presented a more mottled appearance, black however being in excess. The head, bib, and tail were always black. The flight-feathers black with the exception of one or two, the rump frequently white. The back and wing-coverts black mottled with some white, the breast and abdomen white mottled with some black feathers.

##### F. 2 Generation.

EXP. 35.—F. 1 Black with few white feathers ♀ 8 × F. 1 Black with few white feathers ♂ 54.

Both these birds were raised in Exp. 34 and were of the first

TABLE V.

Exp. No.	Parent-age.	♀	Origin from Exp.	Also used in Exp.	Parent-age.	♂	Origin from Exp.	Also used in Exp.	OFFSPRING.			
									Black with few white feathers.	Black in White in excess.	Mottled.	White with few black feathers.
34.		Nun ..... (no number)	—	—		Black Barb ... (no number)	—	—	—	5	—	—
35.	N×B	Black with few white ... 8	34	38	N×B	Black with few white ... 54	34	39	—	—	1	—
36.	N×B	Black mottled with white. 1	34	—	N×B	Black mottled with white. 3	34	—	2	3	—	3
37.	N×B	Black with few white ... 18	34	—	F×B	Black with few white ... 68	1	—	1	2	1	1
38.	N×B	Black with few white ... 8	34	35	F×B	Black with few white ... 71	1	3	2	—	1	—
39.	F×B	Black with few white ... 63	1	{ 3, 5, & 12 }	N×B	Black with few white ... 54	34	35	2	1	2	—
40.	BF×BN	Black ..... 53	38	—	BF×BN	Black ..... 45	39	{ 41 & 42 }	5	—	—	—
41.	BF×BN	Black ..... 65	37	—	BF×BN	Black ..... 45	39	{ 40 & 42 }	4	—	—	—
42.	BF×BF	White ..... 53	3	6	BF×BN	Black ..... 45	39	{ 40 & 41 }	1	2	—	—

type described. They were mated together late in the breeding-season, having both been previously used to cross with Barbfantail F. 1 crosses (*v.* Exps. 38 & 39).

Three young only were produced, of which one was black and white mottled with the white in excess. Unfortunately no details of the markings of this bird were kept. The other two were black with a few white feathers on the abdomen, and on the rump in one of them.

EXP. 36.—F. 1 Black mottled with white ♀ 1 × Black mottled with white ♂ 3.

These two birds raised in Exp. 34 were of the second type described.

Thirteen young were produced :—

Black 2.

F. 1 types 8.

Birds resembling Nun 3.

Of the F. 1 types 5 were black with a few white feathers and 3 black mottled with white. Two of these, recorded as belonging to the first type, died when about a week old in the nest. The others showed only a few white feathers on the abdomen, rump, and vent, and one had three white flight-feathers and a few other white feathers on the wings.

In those recorded as mottled the black was distinctly in excess in one case, and in the other two birds the amount of black and white was about equal. The head, "bib," and tail were black in all cases, and several of the flight-feathers were black. Roughly speaking, the back and wing-coverts showed more black feathers than the breast, abdomen, and under parts. In one case (No. 17) the feathers on the back of the neck and the right wing-coverts were black edged with white, giving a "pepper and salt" appearance to those parts. This peculiarity has not been noticed in any other bird. The following are the details of the markings of the three birds whose plumage somewhat resembled that of the Nun pigeon :—

No. 7. White. Tail black. 2 black flights. A few black feathers on the head. 4 black wing-coverts and one black feather on the breast. The total amount of black was less than in the Nun.

No. 11. White. Tail black. 7 black flights. A few black feathers on the head. The wing-coverts were slightly mottled, the greatest amount of black being in the scapular region. A few black feathers on the breast and rump.

No. 14. White. Tail black. 8 black flights. A few black feathers on the head and at the carpal joint. In this bird again the amount of black is less than in the Nun.

### BARB-FANTAIL-NUN CROSS.

In this small series of experiments the F.1 Barb-Fantails were mated to the F.1 Barb-Nuns. No reversionary blues appeared. The forms produced are scheduled in Table V. Some were definitely black, and the remainder showed combinations of black and white in various proportions. The composition of these latter was not investigated further, but it may be noted that one bird (No. 70) agreed exactly with the F.1 Nun-Fantails described below. As would be expected, no whites appeared.

The further matings show that the extracted blacks in F.2 breed true. No blues were produced; and the black colour was rich and deep in hue, so that no indications of wing- or tail-bars were discernible.

An extracted black mated in Exp. 42 to an extracted white from the Barb-Fantail Experiment gave offspring which were indistinguishable from those produced in F.1 from a black Barb and a white Fantail.

#### *F.1 Barb-Fantails mated to F.1 Barb-Nuns.*

EXP. 37.—F.1 Barb-Nun ♀ 18 × F.1 Barb-Fantail ♂ 68.

EXP. 38.—F.1 Barb-Nun ♀ 8 × F.1 Barb-Fantail ♂ 71.

EXP. 39.—F.1 Barb-Fantail ♀ 63 × F.1 Barb-Nun ♂ 54.

All these birds were black with a few white feathers. The Barb-Fantails were raised in Exp. 1, the Barb-Nuns in Exp. 34. The Barb-Fantails 63 & 71 are the same as used in Exp. 3, and the Barb-Nuns 8 & 54 are those mated together in Exp. 35.

From the three matings twenty young were produced:—

5 Blacks.

7 Black with few white feathers.

7 Mottled.

1 White with a few black feathers in the tail (No. 70).

The notes on the details of the markings of these birds are unfortunately very scanty. In the blacks with a few white feathers the white appeared, when it was noted, on the rump and vent. In one case there was a white flight, and in another there were a few white tail-feathers. Of the seven mottled birds three are recorded as having the white in excess of the black. It was noted that the tail was black in the mottled birds, one bird, however, had one white tail-feather. The head was generally black; the flight-feathers varied, in some cases being all white, and in others mostly black.

#### *Testing the Extracted Blacks from the three foregoing Experiments.*

EXP. 40.—Black BF.BN ♀ 53 × Black BF.BN ♂ 45.

EXP. 41.—Black BF.BN ♀ 65 × Black BF.BN ♂ 45.

♀ 53 was raised in Exp. 38, ♀ 65 in Exp. 37, and ♂ 45 (used in both matings) in Exp. 39.

Nine young birds were produced, all being black.

*Extracted Black mated to Extracted White.*

EXP. 42.—F. 2 Barb-Fantail White ♀ 53 × Black BF. BN ♂ 45.

The extracted White in F. 2 of the Barb-Fantail experiments was raised in Exp. 3, and has in Exp. 6 been shown to breed true to white with a White Fantail. The extracted Black BF. BN is the same used in the two preceding experiments. Seven young were produced, one of which was black without white; the rest were black showing white feathers varying in amount from a small patch on the vent to a distinct mottling. In all cases, however, the amount of black was in excess of the white.

## NUN-FANTAIL CROSSBREDS.

No crosses were made in these experiments between the Nun and the Fantail. Through the kindness of Miss Thiselton-Dyer, however, two ♀ birds were received, the result of such a cross. For the purpose of comparison with the birds produced in the Barb-Fantail-Nun experiment a description of them is given. These birds were white with some black feathers in the tails. One had a tail consisting of fourteen feathers of which five were black. The other had eleven tail-feathers of which three were black. A few of the upper tail-coverts were also black in each bird, but beyond these the plumage was quite white. The irides were black, the beak and claws white, and the eye-wattle or cere flesh-colour, slightly reddish in one. In view of the recessive behaviour of the white from White Fantail elsewhere, it is perhaps remarkable that these birds showed so little colour.

## WHITE TUMBLER-WHITE FANTAIL CROSS.

This cross was made between two white strains of different varieties of pigeons. The Tumbler was of a white strain which is described below. The Fantail used was from the strain kept and already described. Only four matings were made and the experiment carried to the F. 3 generation, and only thirty-six birds were produced. The numbers are scarcely sufficient to give any quantitative results. It was, however, found that colour was produced in the F. 1 generation, and the reversionary blue appeared in F. 2 in conjunction with red and white. These birds are described as Tricolors. Further, in F. 3 a bird was obtained having one blue tail-feather with the terminal black bar.

The appearance of some coloured birds from these matings suggests the possibility that in the White Tumbler a dominant white factor, comparable with that known in fowls, may exist."

## WHITE TUMBLER PIGEON. (Culbutant.)

Nearly every variety of colour, shade, and marking existing in domestic pigeons is found in the Tumbler. There are a few strains

of whites. The ♀ bird used in this cross was obtained from Mr. G. S. Fayle of Birr, King's Co. It was white without any trace of coloured feathers, having the iris white, or "pearl." It was also "long-faced" and "clean legged," *i. e.* free from feathering. Mr. Fayle very kindly gave the following details of his experience in breeding the strain, which has been in his possession for over twenty years. The greatest difficulty in breeding these birds is to obtain a white pigeon having a white eye, as there is a very great tendency for white birds to have dark eyes (*v. infra*). If, however, one or two coloured feathers are present in the plumage the correct eye-colour is more easily produced. Breeders are therefore in the habit of occasionally introducing into their strain a splashed bird in order to improve the eye-colour. Mr. Fayle introduced two hens splashed with red about fifteen years ago, and used them for one breeding-season only. Since then he has never introduced any bird that to his knowledge was bred from other than white parents. He believes, however, that there is hardly a strain of white Tumblers in existence into which splashed birds have not, at some period, been introduced. It was found that the strain occasionally produced birds having a few coloured feathers, seldom more than two or three, which were either black or red. These usually appeared on the head or neck, and sometimes a secondary wing-feather might be tipped with colour. These coloured feathers were frequently not reproduced at the moult. Birds showing these coloured feathers were never selected for breeding. It was further noted that there was a greater tendency for birds having the desired white eye to produce splashed offspring than those having part or the whole of the eye dark. The eye-wattle is white as are also the beak and claws.

#### TYPES OF CROSS-BRED BIRDS PRODUCED.

The birds produced from this series of experiments fell naturally into the three classes of whites, whites with a few coloured feathers or "splashes," and "Tricolors." If a larger number of birds had been produced, it is possible that there might have been some overlapping between the two latter classes.

##### 1. *Whites.*

In every mating of this series of experiments whites have been produced. The number of whites bred was 17; and of the birds showing coloured feathers 19. Owing to limitation of space, extracted whites were not mated together.

##### 2. *Whites with a few coloured feathers.*

The number of coloured feathers on birds described under this class was very small, varying from two isolated feathers to a small patch of about a dozen. In no case was there any approach to mottling. The coloured feathers were in most cases on the neck

or scapular region, and occasionally on the rump or tail. The colour generally found was red, but black, bluish black, and blue were seen. In the few cases in which birds were kept a second year, it was seen that the coloured feathers in one case did not reappear after the moult, and there was also one instance of red feathers being replaced by blackish ones.

### 3. "*Tricolor type.*"

In the F. 2 and F. 3 generations birds were produced which were red and white with some blue feathers. With one outstanding exception (F. 3; 9) birds of this type were fairly uniform in marking. The head and upper part of the neck and throat were white slightly mottled with red. Lower down, especially on the back and sides of the neck, the amount of red increased gradually, and at the root of the neck there were no white feathers. The upper part of the breast was red with a slight bluish tinge between the red and the white of the lower part of the breast and abdomen, on which there were no coloured feathers. Here the line of demarcation between the colour and the white was very distinct and "clean cut." The upper part of the back and scapulars was red, generally of a lighter shade, and resolving itself into a mere powdering, or the "strawberry" shade of the fancier. This was continued slightly on to the proximal wing-coverts where there was mottling with white. The external wing-coverts and all the flight-feathers were white. The lower part of the back below the origin of the wings was white. The rump was light blue, the shafts of the feathers being black. This colour was carried on to the upper tail-coverts. The tail-feathers were generally white, but in two cases some of the external feathers showed a slight blue tinge with the shafts black. Very slight indications of a terminal bar could be made out, especially when the tail was viewed from the under surface. In most cases one or both flanks were blue, the colour being carried down onto the thighs. The rest of the under surface was white.

## DETAILS OF THE MATINGS.

### *Colour.*

The details which follow relate to the successive matings and to the young produced respectively from them. The results are also given in tabular form in Table VI.

### *F. 1 Generation.*

EXP. 43.—White Tumbler ♀ 9 × White Fantail ♂ 18.

Nine young were produced of which six were white, and three showed a very few coloured feathers, as follows:—

No. 1. Two red feathers on the neck which were afterwards moulted out.

No. 5. A few feathers tinged red on the right scapular region. This bird changed slightly during the moult. It then had four blackish tinged feathers on the right scapular region, the red colour having disappeared.

No. 7. Also had a few feathers tinged red on the scapular region.

TABLE VI.

Exp. No.	♀	Origin from Exp.	♂	Origin from Exp.	OFFSPRING.		
					White	White with few coloured feathers.	Tricolor.
43.	White Tumbler .....	9 —	White Fantail .....	18 —	6	3	—
44.	F. 1 White with few } coloured fthrs. }	5 43	F. 1 White with few } coloured fthrs. }	1 43	4	4	2
45.	F. 2 White with few } coloured fthrs. }	13 44	F. 2 White with few } coloured fthrs. }	15 44	4	5	—
46.	F. 2 Tricolor .....	7 44	F. 2 Tricolor .....	8 44	3	—	5

## F. 2 Generation.

EXP. 44.—F. 1 White with few coloured feathers ♀ 5  
× F. 1 White with few coloured feathers ♂ 1.

These birds, raised in Exp. 43, are described above. Ten young were produced, of which four were white, and six showed some coloured feathers. These latter were divisible into two groups: one, of which there were four birds produced, was white with a few coloured feathers as in the F. 1 generation; the other, of which two birds were produced, was of the tricolor type, previously described. Of the whites with a few coloured feathers, No. 13 had one feather showing both red and black on the right scapular, and one black feather on the rump.

No. 14 had two black feathers on the neck and one on the back.

No. 15 had two red feathers on the neck and three on the right scapulars.

No. 18 had several red feathers on the scapulars.

The details of the two birds recorded as tricolors (Nos. 7 and 8) coincide very closely with the description of the type already given.



## F. 3 Generation.

EXP. 45.—F. 2 White with few coloured feathers ♀ 13  
× F. 2 White with few coloured feathers ♂ 15.

These birds, raised in Exp. 44 and described above, produced nine offspring when mated together, four of which were white, and five white with some coloured feathers. Of those in the latter class four showed a few red feathers on the back of the neck, and in one instance on the left scapular. No black or blue feathers were seen on these birds. The fifth (No. 112), however, had no coloured feathers on the neck, but on the right wing-coverts was a large patch of feathers tinged red and edged with black, also one tail-feather blue with a terminal bar, the rest of the tail and plumage being white.

EXP. 46.—F. 2 Tricolor ♀ 7 × F. 2 Tricolor ♂ 8.

These two birds raised in Exp. 44, and of the type described, produced eight offspring, three of which were white and five tricolors. The details of four of the tricolors approximate closely to the type. In two of them blue was present on the breast, flanks, and rump. On one it was present on the flanks only, and in another there were only slight indications of blue on the rump. In the bird showing most blue there was a slight blue tinge on some of the tail-feathers. The fifth coloured bird (No. 9), produced from this mating, showed, in addition to the typical red on the neck and breast, a large amount of bluish-black colour. The left scapulars and proximal wing-coverts were light reddish feathers edged with black, and blue feathers chequered with black were interspersed among them. The right scapulars were blue chequered with black. The remainder of the plumage, including the under parts, was white with the exception of a single blue feather on the rump.

## IRIDES.

The irides of pigeons are chiefly of three colours, white, orange, and black. On each the blood-vessels of the iris can be seen very distinctly and, in some cases, give a very well-marked red appearance most noticeable at the periphery.

The white, or, as it is called by fanciers, the "pearl" eye breeds true in many varieties of pigeons, but in some it is apt to throw orange- and black-eyed birds. The latter is stated to be more easily "bred out" from a strain than the former. The orange iris is found in *Columba livia*, and appears to breed true in several fancy varieties. The black iris (termed by fanciers "hazel" or "bull" eye, which is, more correctly speaking, a brownish-black), seems to breed true invariably. In the nest the irides of all the young pigeons examined were black, but in birds in which this was not the eye-colour of the adult, the colour

changed to white or orange usually within two months after hatching. In the foregoing experiments no matings were made specially to test the inheritance of the colour of the iris, and this character has only been studied incidentally. From lack of space it was found necessary to kill many of the young birds before the colour of the iris in the adult state could be noted; and in the earliest experiments no notes were taken of the minor characters presented.

Some few cases were met with in which the colour of the iris did not completely change, but a small segment of one iris remained permanently black, or the greater part of both irides was black and only a small part showed white or orange. One bird was bred having one iris black and the other orange, but this appeared to be a very exceptional case.

The Barb pigeon has generally a white eye, although black Barbs are sometimes seen with orange eyes. White Barbs have been seen with white eyes, but nearly always have black. Of the four black Barbs used, those in Exps. 2, 27, and 34 had white irides. That used in Exp. 1 is believed to have had an orange iris, the notes of this experiment referring to plumage colour only. The white Fantails had black irides; coloured Fantails, on the other hand, have either white or orange. The black and white Nun had white irides. The white Tumbler also had white irides; this character has been specially referred to in the description of the Tumbler.

In the four series of experiments irides were obtained as follows:—

Barb-Fantail Cross gave white, orange, and black.

Barb-Nun Cross gave white only.

Barb-Fantail-Nun Cross gave white, orange, and black.

Fantail-Tumbler Cross gave black only.

There appears to be a very distinct association between white plumage and black iris, and, in a lesser degree, between black plumage and white iris, as the following tables show (p. 100). Here the birds are grouped irrespective of the generations to which they belong.

In the case of the blue birds with some white feathers there appeared to be a general, though not invariable, rule that the birds showing the greatest amount of white had black irides and those with fewer white feathers orange irides.

The tables show very conclusively the relation between the white plumage and black irides. This correlation extends to the whites with some coloured feathers, and even to the mottled birds in which white is in excess. It is further seen that no black bird has a black iris, and the black iris is also exceptional in black birds with some white feathers. In the Barb-Fantail cross there appears to be a correlation between the white iris and black plumage; the figures, however, of the Barb-Fantail-Nun cross, although small, do not bear this out.

The doubtful record of the iris of the Barb used in Exp. 1, and the absence of notes on the irides in some of the earlier experiments, makes the tracing of inheritance of this character very unsatisfactory.

#### Barb-Fantail Cross.

	White.	Orange.	Black.
Black .....	15	1	0
Black with some some white feathers .....	18	6	2
Blue .....	9	13	2
Blue with some white feathers .....	10	20	20
White .....	0	0	48
White with some coloured feathers .....	0	0	11
Red .....	5	0	0
Dun .....	1	0	0

#### Barb-Fantail-Nun Cross.

Black .....	3	9	0
Black with few white feathers .....	6	3	1
Mottled, black in excess .....	2	1	0
Mottled, white in excess .....	0	0	3
White with few coloured feathers .....	0	0	1

A very clear result is, however, obtained in Exp. 2, which was made later. In this case a Barb with a white iris was mated to a Fantail with a black iris, and the four young produced had white irides. Two of these mated together in Exp. 4 gave 13 birds with white irides, and 4 with black. Three other young were produced, but were killed before the colour of the iris could be ascertained. This, therefore, gives the simple 3 : 1 Mendelian proportion in F. 2, white being dominant.

The remaining crosses, both of the Barb-Fantail and the Barb-Fantail-Nun experiments were, unfortunately, all made with birds descended from the Barb used in Exp. 1.

The results of these experiments are grouped together in the following tables irrespective of the generations to which the birds belonged.

## Barb-Fantail Cross.

Colour of irides of parents.	White.	Orange.	Black.
Orange $\times$ Orange .....	0	21	8
Black $\times$ Black .....	0	0	14
White $\times$ Black .....	7	0	2
Orange $\times$ Black .....	4	9	26
White $\times$ Orange .....	25	6	17
Barb-Fantail-Nun Cross.			
White $\times$ White .....	6	0	2
Orange $\times$ Orange .....	2	2	0
Orange $\times$ Black .....	0	3	1
White $\times$ Orange .....	3	8	2

In connection with the above tables it may be noted that in the matings of orange  $\times$  black irides, the excess of blacks over oranges in the offspring is in some measure associated with the excess of white-plumaged birds over blues in Exps. 16-23 where equality was expected. Further, in the White  $\times$  Orange experiments, all the offspring from two matings, amounting to 12 birds, had white irides.

The bird already mentioned as having one iris black and the other orange was raised from ♀ with black irides  $\times$  ♂ with orange. This bird when mated to a bird with black irides gave 5 young all with black irides.

In the Barb-Nun experiment 21 birds were reared to an age at which the adult colouring of the iris showed itself. In all these foregoing birds the irides were white. In the two Nun-Fantails described the irides were black. The Tumbler-Fantail cross is exceedingly interesting in respect of the irides. As has been stated, white irides cannot be kept in a strain of white Tumblers without the occasional introduction of birds having some coloured feathers. In the cross between the white-eyed Tumbler and the black-eyed Fantail, 36 birds were raised. Of these 35 had black irides, and one had a small part of the left iris white, the remainder being black. This was a splashed bird in the F. 2 generation (Exp. 44, No. 14).

The foregoing facts as far as they go suggest the conclusion that the black iris is correlated with the white plumage, and that

possibly there may also be, although in a much lesser degree, some correlation between the white iris and the black plumage. The figures respecting blue birds are not so conclusive, but seeing that the orange iris is the only one found in *C. livia*, the suggestion may be hazarded that there is possibly some correlation between the orange iris and blue plumage. The matter becomes more complex when we study the blue and black birds in the plumage of which white feathers occur. It is, however, suggested that the amount of white present in the plumage may have some influence on the determination of the colour of the iris. Whether the association of certain eye-colours with certain types of plumage-colour arises through gametic coupling or not cannot yet be positively asserted.

With regard to the question of dominance, it has already been shown that white is a simple dominant to black in the case where the record of the irides of the original parents was kept, and a Mendelian ratio of 3:1 was obtained in F. 2. In the table of the Barb-Fantail-Nun cross also, a 3:1 ratio was given when birds having white irides were mated together. It is further shown that extracted black irides breed true without exception.

Further experiments are necessary before the relation of orange to black, and white to orange can be definitely asserted. It appears probable, however, that black will be eventually found to be recessive to orange, and that orange may be recessive to white.

#### BEAKS AND CLAWS.

In the Barbs used the beaks were either white tipped or tinged with black, or were horn-colour. The claws also were horn-colour. In the white Fantails the beaks and claws were white; they were also white in the white Tumbler, and in the Nun they were black. In the Barb-Fantail and Barb-Nun-Fantail crosses the following types of beaks and claws were met with:—(1) Birds having quite black beaks; in these the claws were usually black, sometimes white, and sometimes mixed, some of the claws of an individual being black and others white. (2) Birds having white beaks with some dark pigment. This might be a white beak tipped with black, or one mandible might be black and the other white, or the beak might be of a general horn-colour. In these birds the claws were usually mixed, but some individuals were produced having all the claws black, white, or horn. (3) Birds having white beaks; these invariably had white claws. [One bird only is recorded as having a white beak and black claws, it was black in plumage, and was killed when only just over a fortnight old. The record is probably erroneous, and had the bird reached maturity it would have been found to have a white beak tipped with black.] There is a very marked correlation between the colour of the beak and claws and that of the plumage. White beaks and claws have been found on every white-plumaged bird bred, also on whites with some coloured feathers, and reds. Black

and Blue birds with or without white feathers, on the other hand, have beaks of types 1 or 2, there being some black present in the beaks. Five exceptions, however, occurred; these were blue birds with a large amount of white in the plumage, having white beaks and claws. In the Barb-Nun cross the beaks and claws of the birds in the F. 1 generation were black. In F. 2 four birds were produced having white beaks tipped with black and some white claws. The remaining birds of the F. 2 generation had beaks and claws black. In the Tumbler-Fantail cross the beaks were white with the exception of a bird in F. 2 (No. 14, Exp. 44), which had the lower mandible tinged blackish. The claws were white throughout. The general conclusion is that pigment in the beak, and to some extent in the claws, is correlated with certain types of plumage. Acting thus it is allelomorphic to white, and is a simple Mendelian dominant.

#### EYE-WATTLES OR CERES.

In the Barb the eye-wattle is large. It increases in size with age, and has been seen measuring one inch in diameter. It presents the appearance of a series of naked nodules of skin arranged in two or three concentric rows. In colour it is bright red. In the three other varieties used in these crosses the wattles are very small. In colour those of the white Fantail and white Tumbler are white or pale flesh-coloured, that of the Nun blackish. In size the wattles of the F. 1 generation from a Barb were intermediate; some large wattles were observed in the F. 2 and subsequent generations, but these never assumed the proportions of those of the pure Barb. It was noticed that these large wattles were always red, but they were present on birds having black, blue, or white plumage.

Observations on the colour of the wattles of birds in the Barb-Fantail crosses have been somewhat complicated by the fact that many birds, which were subsequently seen to have red wattles, when young showed wattles of a yellowish colour which were scarcely distinguishable from the flesh-coloured wattles of the Fantail. The general result, however, appears to be that red is a simple dominant over flesh-colour. In the F. 2 generation one blackish wattle was obtained, and some others were found in the further generations. In one experiment birds possessing these wattles were mated together, with the result that offspring showing all these kinds of wattles were produced. Occasionally birds with wattles coloured partly red and partly black, or partly white and partly black, were produced. Whether these wattles would have changed their colour later in life cannot be stated.

The colour of the wattles in the Barb-Nun cross is not very clear. Birds of the F. 1 generation had blackish wattles with, in one or two cases, a little red at the periphery. In F. 2 some birds with red wattles were obtained, two with white wattles, and some with mixed wattles. Little reliance, however, can be placed on

this result as the experiment was very small and the young birds were killed before they reached maturity. In the Barb-Fantail-Nun crosses red, yellow, black, and mixed red and black wattles were obtained. The yellows might possibly have changed to red. No flesh-coloured wattles were recorded. The two Nun-Fantails, however, had flesh-coloured wattles. In the Tumbler-Fantail experiment the wattles were flesh-coloured throughout.

Owing to the various changes occurring in this character during the life of an individual, it is by no means a satisfactory subject for experiment.

#### CONCLUSION.

The experiments here recorded have been subsidised by the Government Grant Committee of the Royal Society. The writer is indebted to Mr. J. H. Elwell for much kind assistance.

The matings, throughout, have been made in consultation with Mr. Bateson, who has most kindly supervised the experiments. He has also read the manuscript for the present report, and made many very valuable suggestions and alterations. To him the writer desires to express his sincere thanks.

#### EXPLANATION OF THE PLATES.

##### *Black Barb-White Fantail experiment.*

PLATE IV. Fig. 1. Black with some white feathers.

Fig. 2. White with black patch. (Exp. 5.)

PLATE V. Fig. 1. Reversionary blue.

Fig. 2. Reversionary blue, dark type. (Exp. 5.)

PLATE VI. Fig. 1. Blue with some white feathers.

##### *White Tumbler-White Fantail experiment.*

PLATE VI. Fig. 2. White with few coloured feathers (black).

PLATE VII. Fig. 1. White with few coloured feathers (red).

Fig. 2. Tricolor.

2. The Duke of Bedford's Zoological Exploration in Eastern Asia.—IX. List of Mammals from the Mongolian Plateau. By OLDFIELD THOMAS, F.R.S., F.Z.S.

[Received January 21, 1908.]

After making the collection in the Shantung Peninsula referred to in a previous part of the present series, Mr. Malcolm Anderson made a trip to the Mongolian Plateau, reaching a point about 100 miles N.W. of Kalgan, and collected there the series now enumerated.

The fauna of this region, as was pointed out by Père David, is exceedingly poor, and Mr. Anderson was in consequence only able to get nine species, but these are all of interest, and form a valuable nucleus for further work in Northern China. Most of

them are represented by excellent series of the perfectly prepared skins to which Mr. Anderson has now accustomed us, skins of a very different character to any on which work in Eastern Asia has hitherto had to be done.

Mr. Anderson's notes on the trip are as follows :—

"On the 16th July, 1907, I left Kalgan (Jang-kia-kou), in North-western Chih-li Province, for the Mongolian Plateau. Some twelve miles north-west of Kalgan we began the ascent of the escarpment, and about 18 miles from that city found ourselves at the summit of the range of mountains which, in this part, borders the plateau. From here we descended some hundreds of feet to reach the general level of the tableland. We travelled two days over the plateau, till, on the evening of the second, we reached Taboul (Five Hills), at a point 100 miles north-west by north from Kalgan. Here, at an elevation of approximately 5000 feet, the country is of rolling hills with only occasional level stretches. There is not a tree, nor even a bush, in the region, but the hills bear abundant grass, which makes this district the best pastureland in Mongolia. It is, indeed, the district from which the Chinese Government draws its supply of cavalry-horses. Sheep, goats, kine, camels, and horses are raised by the natives, who have no other means of livelihood.

"In general the rainfall is meagre, but it chanced that during my stay, between July 18th and August 13th, there were almost daily rains, which often came in the shape of cloud-bursts, coming up in the south-west and disappearing in the north-east. Heavy dews fall nightly. I was informed that the winters are cold with piercing winds, but the snowfall is not great."—*M. P. A.*

1. *VULPES* sp.

♂. 1487.

Too young for determination.

"A family of foxes was in the Taboul neighbourhood when I went there, but they were evidently very shy, for on seeing us one day they forsook the place and did not return."—*M. P. A.*

2. *CITELLUS MONGOLICUS* M.-Edw.

♂. 1475, 1477, 1493, 1499, 1500, 1502, 1516.

♀. 1479, 1483, 1501, 1503, 1504, 1510, 1533.

These specimens are certainly referable to *C. mongolicus*, whether that animal is or is not synonymous with *C. brevicauda* Brandt, as has been asserted.

Mr. Campbell has obtained some examples of the species at Hara-ussu, not far from the present locality.

The Old-World *Citelli* are very unsatisfactorily known, and this plentiful series will be of much assistance in working out the group.

"Very common; diurnal.

"On our trip into Mongolia, both going and returning, I saw great numbers of these animals along the road. Particularly in



one locality, about 70 miles from Kalgan, they have a large colony, and there the burrows are about the sides of mounds overgrown with bush-grass. At Taboul I found them living about the hill-sides, and their burrows not distinguished from those of other mammals."—*M. P. A.*

### 3. *MERIONES UNGUICULATUS* M.-Edw.

♂. 1473, 1478, 1485, 1486, 1489, 1492, 1495, 1506, 1507, 1514, 1539.

♀. 1464, 1469, 1470, 1471, 1474, 1496, 1505, 1511, 1512.

A female in spirit, with 2—2=8 mammae.

These specimens quite agree with a typical specimen in the Museum from "Chinese Mongolia" received from the Paris Museum. None of them shows any approximation in the character of the claws to an example of *M. psammophilus* M.-Edw., which was collected in the near neighbourhood of Kalgan, but which Mr. Anderson did not chance upon.

"This, the most abundant mammal, was literally almost everywhere throughout this part of Mongolia. They are diurnal to some extent, but may be most frequently seen between sunset and dark, when they sit spermophile-like before their burrows. I frequently succeeded in approaching within about eight feet of a sitting individual, during which manœuvre the animal would eye me steadily and, finally, with one rapid move, plunge into his hole, but reappear after a few moments if I remained perfectly still. These animals make a curious sound beneath the earth; it sounds very much like the distant galloping of a horse on a hard road, and I was much puzzled about it for some days. How the sound is produced I do not know."—*M. P. A.*

### 4. *MUS WAGNERI* MONGOLIUM, subsp. n.

♂. 1472, 1520. ♀. 1480, 1481, 1484, 1532.

A white-bellied Mouse of the *musculus* group, not so pale as true *wagneri*.

General colour above rather paler than Ridgway's "broccoli-brown," the light rings on the hairs below "écru-drab" and pinkish buff; sides rather paler than back, but not approaching to clear buffy of true *wagneri*. Whole of under surface, hands, and feet pure white, the hairs white to their bases; line of demarcation on sides very sharply defined. Ears like head, their proectote little darker. Tail rather short, inconspicuously bicolor, brown above, dull whitish on sides and below.

Dimensions of the type, measured in the flesh:—

Head and body 82 mm.; tail 50 (range up to 56); hind foot 15.5; ear 12.5.

Skull—greatest length 21.5 mm.; basilar length 17; zygomatic breadth 11.3; nasals 7.9; palatilar length 9.5; palatal foramina 4.7; length of upper molar series 3.3.

Type. Old female. B.M. No. 8.3.5.36. Original number 1484. Collected 28th July, 1907.

Accepting Dr. Büchner's identification of the pale Central-Asian White-bellied House-Mouse as *M. wagneri*, I feel compelled to give a racial name to its representative in Eastern Mongolia and China, on account of its much darker colour, which is quite uniform in all the specimens obtained by Mr. Anderson. Of the true *M. wagneri* we have for comparison two specimens from the Prjewalski collections, received from the St. Petersburg Museum.

"Found only about the tents of the Mongol village where I lived. They were very bold, but did not do much damage."—*M. P. A.*

##### 5. *CRICETULUS GRISEUS OBSCURUS* M.-Edw.

♂. 1513, 1522, 1523, 1529, 1530, 1536, 1537, 1545.

♀. 1518, 1519, 1524, 1528, 1538, 1543, 1544.

♀ in spirit.

These specimens, all in summer pelage, differ from the Chefoo series of *griseus*, which are in winter dress, by being slightly darker in tone, as compared with the very grey colour of the latter animals. Whether this difference in colour is solely due to season remains to be seen when further specimens representing other seasons are available for examination.

In addition, the Mongolian specimens seem to have on the average rather larger teeth, but the difference is not quite constant.

Milne-Edwards's *Cricetulus obscurus* was described from Sartchy, some 200 miles S.W. of the present locality, and I think Mr. Anderson's specimens may be provisionally referred to it, and that it might be considered as a subspecies of *C. griseus*.

##### 6. *CRICETULUS CAMPBELLI* Thos.\*

♂. 1465, 1466, 1468, 1498, 1525, 1527, 1534, 1535, 1546.

♀. 1467, 1482, 1497, 1526, 1547, 1548.

Although there are certain discrepancies between the measurements of these specimens, as taken in the flesh by Mr. Anderson, and those recorded by me from Mr. Campbell's spirit-specimens, the agreement in all other respects is too exact, and the localities are too close to each other, for there to be any genuine racial difference between the two. Probably variations in the method of measuring the minute tail, and the contracting effect of alcohol on the ears would account for such differences as exist.

The beautifully marked Hamsters of this group have hitherto been exceedingly rare in collections, and the nice series obtained by Mr. Anderson is of much value.

The following are the flesh-measurements of two old examples:—

♂. Head and body 88 mm.; tail 14; hind foot 12; ear 13.

♀. " " 90 " ; " 11; " " 12; " 14.

\* Ann. Mag. N. H. (7) xv. p. 322 (1905). The position of the type locality was incorrectly given in this description, owing to a confusion between two similar names. The proper position is about 42° 40' N., 116° 20' E.

"I did not discover much difference in the habits of these two Hamsters, but I believe that the long-tailed form (*C. griseus*) burrows for itself, while the short-tailed one (*C. campbelli*) is more inclined, at least in this region, to take possession of holes of the Red-tailed Rat (*Meriones*). Both species live on the seeds and leaves of small plants, among which they can often be seen running about in the late evening. Both species are abundant."—*M. P. A.*

7. *MICROTUS ANGUSTUS*, sp. n.

♂ (old). 1517. Mongolian plateau. Alt. 5000'. 4th August, 1907. B.M. No. 8.3.5.63. *Type*.

A large pale species of the "*Stenocranius*" group.

Size about as in *M. (Stenocranius) slowzowi* Kastch. General colour pale isabella, resulting from a coarsely lined mixture of dull buffy and brown. Sides clearer buffy; a marked buff patch, probably glandular in nature, just in front of the hips. Hairs of under surface cream-buff terminally, the grey bases to the hairs showing through. Sides of muzzle and tufts at bases of ears rich buffy; the head otherwise like the body. Ears rather short, not projecting above the (summer) fur, the short hairs clothing its edges pale buffy. Hands and feet uniformly dull buffy above; pollex with a small nail. Tail well clothed, dull buffy, with a narrow rather darker line along its upper surface. Skull of the extreme "*Stenocranius*" type, very long and narrow, as shown by the measurements given below. Palatal foramina rather short. Posterior palatal pits deep, the septum between them very narrow. Opening of posterior nares narrow, angular. Bullæ of average size.

Teeth of the usual *arvalis* type,  $m^3$  with four spaces and a posterior crescent.  $M_3$  with six spaces and an anterior trefoil.

Dimensions of the type, measured in the flesh:—

Head and body 112 mm.; tail 32; hind foot 17; ear 10.5.

Skull—greatest length 26.8 mm.; basilar length 24; zygomatic breadth 12.9; nasals  $7 \times 3.1$ ; interorbital breadth 3; posterior breadth 11; palatilar length 13.8; palatal foramina 5.2; length of upper tooth-series (crowns) 5.7.

*Hab.* and *type* as above.

This Vole is an extreme member of the narrow-headed group called *Stenocranius* by Kastchenko, but I fail to identify the species with any hitherto described. Radde's *Arvicola mongolicus* is a dark-coloured species ("dorso fusco"), *Microtus raddei* and *M. gregalis* are smaller, while *M. slowzowi* and *M. tianshanicus*, to which the dimensions most nearly relate it, are from localities so widely distant, with other species intervening, that it cannot possibly be either of them.

"Probably rare. Caught by hand among grass and weeds in the middle of the afternoon. No other specimens could be found, and there were no burrows about."—*M. P. A.*

[*ALLACTAGA MONGOLICA* Radde.

*Dipus jaculus*, var. *mongolica* Radde, Reise S.-O. Sib., Säug. p. 170 (1862).

*Dipus (Jaculus) annulatus* M.-Edw. Rech. Mamm. p. 149 (1868-74).

♀. Hara-Ussu, N.W. of Kalgan. C. W. Campbell.

The specimen obtained by Mr. Campbell at Hara-Ussu nearly resembles a co-type of *A. annulata* received from the Paris Museum, and collected by Père David on the "plateaux sablonneux de Mongolie," no doubt not very far from the present locality. But the animal would seem to be referable to the earlier-published *A. mongolica*, described by Radde from the northern edge of the Mongolian plateau.]

# 8. *LEPUS TOLAI* Pall.

♂. 1462. ♀. 1463, 1490.

In 1898 two specimens of this same Hare were obtained by Mr. C. W. Campbell at Hara-Ussu. All are in summer pelage, so that it is not easy at present to define their differences from the Chefoo and Peking Hare, *L. swinhoei* Thos., which Mr. Anderson collected in winter and early spring.

"Common in certain localities. The Hare in Mongolia is rather strangely fond of the proximity of the native encampments. The people say that they come near the camps for protection from wolves, and this seems probable, for the Hares have nothing to fear from the people, while the Mongol dogs, though fierce and strong enough to make even a wolf think twice, are probably seldom swift enough to catch a Hare, and, being used merely as watch-dogs, they are kept close to the tents."—*M. P. A.*

# 9. *OCHOTONA DAURICA* Pall.

*Lepus dauricus* & *L. ogotona* Pall.

♂. 1488, 1491, 1508, 1515, 1540.

♀. 1476, 1509, 1521, 1531, 1541, 1542.

These specimens agree in all essential characters with the specimen from Urga, N.W. Mongolia, figured by Büchner as representing Pallas's species. With the exception of a faded dealer's skin from "Amurland," they are the first examples of this species that the Museum has received.

There can be no doubt that Pallas's specific names *ogotona* and *dauricus* both belong to the same animal, as explained by Büchner; and Bonhote's recent differing from the latter\* is due to his having accepted as correct an old determination of the Museum specimen No. 45.4.21.5, which was bought from the dealer Brandt under the name of *Lagomys ogotona*, and said to come from "Asiatic Russia—Kirgisen."

But this specimen, which is certainly not *ogotona* (= *daurica*), is the type of *Ogotoma pallasii*, a name given by Gray to Water-

\* P. Z. S. 1904, ii. p. 216.

house's *Lagomys ogotoma*, the description of which was based on this specimen, while the skull characters of the genus *Ogotoma*, as given by Gray, were also drawn up from it. And it has been again redescribed by Bonhote as *Ochotona ogotona*, and stated to be nearly related to *O. ladacensis* Günth.

The name *O. pallasi* and the descriptions above quoted will therefore have to be reckoned with by future writers about this difficult group.

"Not common—somewhat diurnal. Frequents the hill-sides where grows a stiff fragrant weed on which it seems to feed. In several old fox-burrows I found great masses of cuttings of this weed, and in that immediate vicinity trapped five of the series. Their burrows are not clean-cut and vary greatly in diameter. Where several of these animals live near together their holes are connected on the surface by a network of little trails. The presence of these animals is generally betrayed by little piles of spherical droppings at the mouth of the burrow, indicating also that the occupants are cleanly in habit."—*M. P. A.*

### 3. Descriptions of new Species of Butterflies of the Division Rhopalocera from Africa and from New Guinea. By G. T. BETHUNE-BAKER, F.L.S., F.Z.S.

[Received January 21, 1908.]

(Plates VIII. & IX.)\*

#### ACREA BENI, sp. n.

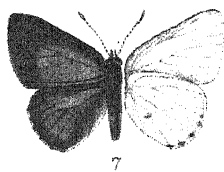
♂. Both wings bright orange-red. Primaries with termen and apical half of costa linear, black, with all the terminal parts of the veins outlined finely with black, tapering finer basewards; a black spot in the cell, another at the end of the cell, beyond this three subcostal confluent small spots with a larger one shifted outwards between veins 4 and 5 and a smaller spot below it between 3 and 4, a spot below the end of the cell, two between veins 1 and 2, one near the base and one near the termen. Secondaries with costa narrowly black, with a subterminal scalloped line confluent with the costa along the veins, terminal part of veins slightly marked with black, base irregularly restrictedly black; a series of three subbasal spots, that in the cell shifted slightly outwards, a spot at the upper end of the cell; a curved series of postmedial spots, that near the angle of vein 2 shifted well inwards with one below it shifted well outwards.—*Under side*. Primaries as above, but paler. Secondaries ochreous, with pink internervular stripes; the spots as above, but smaller, and the base broken up into five or six spots instead of being all confluent as above.

♀. Both wings dirty brown, with smaller spots and no basal spot in the fold of the primaries. Secondaries with the black

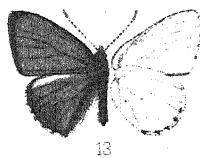
\* For explanation of the Plates, see p. 126.



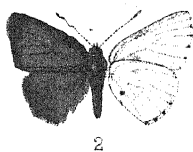
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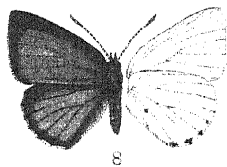
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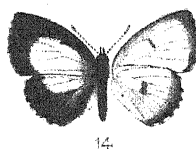
13



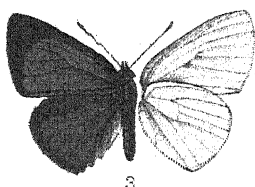
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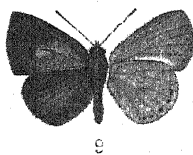
8



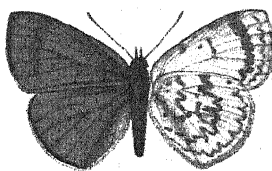
14



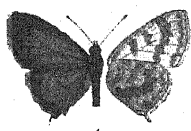
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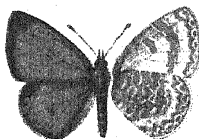
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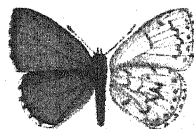
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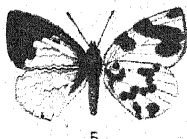
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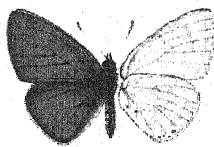
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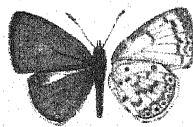
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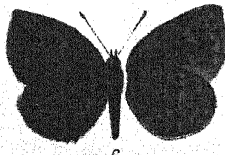
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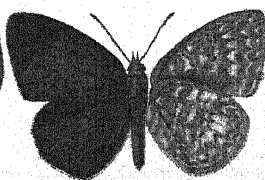
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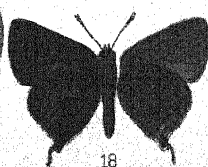
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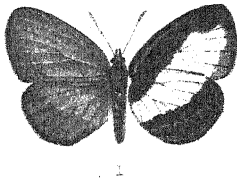
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E.C. Knight ad nat. del.

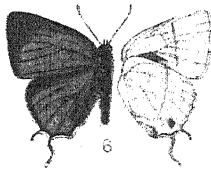
West, Newman chromo.

NEW OR LITTLE KNOWN LYCÆNIDÆ.

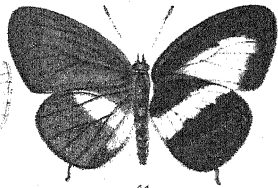




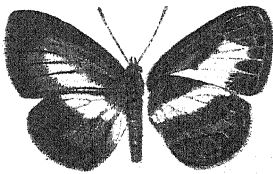
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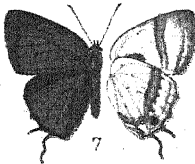
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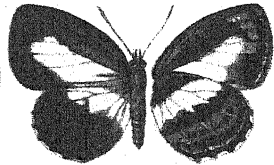
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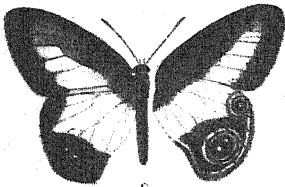
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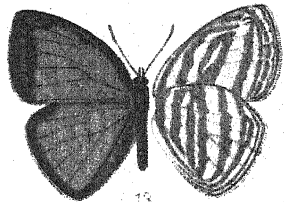
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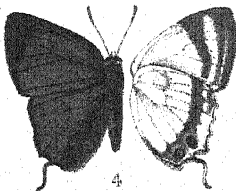
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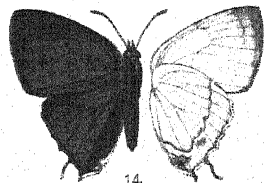
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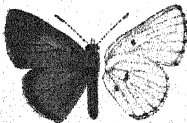
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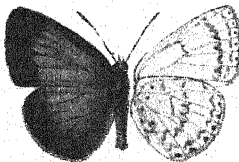
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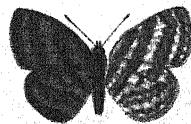
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5



10



15

E.C. Knight ad nat. del.

West, Newman chromo.

NEW OR LITTLE KNOWN LYCENIDÆ.





termen heavily accentuated. Under side like the male, but dirty ochreous.

Expanse, ♂ 52, ♀ 56 mm.

*Hab.* Angola.

Types in my collection.

*PENTILA MULTIPLAGATA*, sp. n.

Thorax black; abdomen pale tawny.

Both wings tawny, with somewhat scalloped very broad black outer margins. Primaries with costa narrowly black, with two blackish spots over the cell, a larger one at the end of the cell, and three postmedial spots in a curve from vein 1 to 3, one between each vein. Secondaries with a spot closing the cell, and a postmedial series of seven spots following the course of the black termen, the lower three spots being more basewards than the upper four.—*Under side.* Primaries tawny, with apical half of termen yellowish. Three spots over the cell, one closing it and another spot between veins 1 and 2 near the angle; a postmedial series of eight spots beginning at and above the third costal spot; a subterminal series of six spots, the apical three being broad dashes, the tornal three being largish spots. Secondaries paler than primaries; a curved series of five basal spots, the one on the costa and that in the cell very small, the three lower curved ones large, ending below the angle of vein 3; a postmedial series of nine large spots, extending around the greater portion of the wing; a subterminal series of seven large spots.

Expanse 40 mm.

*Hab.* Makala, Congo Free State.

In the Powell-Cotton collection.

This species belongs to the *P. amenaïda* Hew. group.

*CITRINOPHILA UNIPUNCTATA*, sp. n.

♀. Both wings lemon-yellow. Primaries with apical area broadly black in a fairly even curve internally, except that there is a slight break at vein 4, tapering down to about vein 2, where it ends. Secondaries with termen very finely black, frequently interrupted by the yellow ground.—*Under side.* Both the wings paler lemon-yellow, with a single black spot at the end of the cell in each. Primaries with the black apex showing slightly through, the costa and termen finely dotted with black all round. Secondaries with termen finely dotted with black at the veins.

Expanse 34 mm.

*Hab.* Makala, Congo Free State: March.

In the Powell-Cotton collection.

*DEUDORYX MAKALA*, sp. n. (Plate IX. fig. 4.)

♂. Both wings brilliant metallic bluish green, of a tone of colour not uncommon in the Neotropical *Thecla*, but very unusual in the Western Hemisphere. Primaries with costa narrowly black; apex broadly black, tapering narrowly to about vein 2.

Secondaries with costa blackish to vein 7, a small round creamy sex-spot on the upper margin of the cell; termen with a fine linear black line with white fringes.—*Under side*. Both wings white. Primaries with a very broad olive-brown termen, having a fine intersecting white line from the tornus to vein 4 or 5, and a second short fine white intersecting external dash from the tornus to about vein 2; a very broad, olive-brown, waved tapering post-medial band immediately beyond the cell right across the wing, a small pencil of black hairs a third from the base of the inner margin. Secondaries: apex with a short apical olive-brown dash and a very broad olive-brown subterminal band from just beyond the apex to the anal angle, the anal portion largely suffused with orange-red, a deep black oval spot between veins 2 and 3, with a smaller black lobe-spot somewhat suffused with very pale bluish-metallic scales; sex-spot showing through olive-brown.

Expanse 32–36 mm.

*Hab.* Makala, Congo Free State: June.

In my collection and in that of Major Powell-Cotton.

This species is nearest *Hypolyccena naara* Hew., but has no sex-spot in the primaries.

*DEUDORYX ITURI*, sp. n. (Plate IX. fig. 7.)

♂. Both wings lustrous cobalt-blue. Primaries with costa narrowly black; apex very broadly black, tapering gradually to the tornus, the blue area being gradually rounded off externally. Secondaries with costa blackish to vein 7; termen linear, black; a fair-sized creamy sex-mark above the cell, and a small pencil of black hairs between veins 1 and 2.—*Under side*. Both wings white, with apex and termen of primaries broadly grey, with a whitish bisecting line; postmedial line broadly fawn-yellow, occasionally nearly straight, but generally with an internal curve more or less strong; inner margin with a pencil of pale yellow hairs about a third from the base. Secondaries with termen broadly grey, with a whitish bisecting line, an oval black spot between veins 2 and 3 in a large pale yellow patch extending more or less to the lobe, which has a small black spot with a slight metallic-blue edging above, over which is an angled orange-red line. Post-medial line broadly yellow, broken at vein 4, with a double angle between veins 1 and 3. The sex-spot showing through very slightly. Two tails, one at vein 2, another at 3; at 4 a tooth.

Expanse 33–36 mm.

*Hab.* Makala, Congo Free State: April.

In my collection and in that of Major Powell-Cotton.

*DEUDORYX ELEALODES*, sp. n. (Plate IX. fig. 6.)

♂. Both wings bright blue, not lustrous. Primaries with the apex broadly blackish, tapering very rapidly off on the costa and less rapidly on the termen to the tornus, where it is linear. Secondaries with costa blackish to vein 7. Tail at vein 2 long and fine, at vein 3 quite short. The small sex-patch between

veins 1 and 2 similar to that in *D. eleala* Hew. Lobe slightly developed.—*Under side*. Both wings dirty whitish all over, without any grey border to the termen. Primaries with a narrow, very slightly oblique, pale yellow postmedial line tapering into a point on the fold; subterminal line obscure, very pale yellow; a sex-pencil of black hairs on the fold. Secondaries with the two lines of the primaries continued through. Lobe-spot black, very small, with a minute spot of metallic-blue scales above; second spot in a patch of obscure very pale yellow, with a trace of whitish-blue submetallic scales at its upper edge.

Expanse 26–32 mm.

*Hab.* Makala, Congo Free State.

In my collection and in that of Major Powell-Cotton.

This species is a near ally of *D. eleala* Hew., but the blue of the upper side is quite different—being blue, not green; the under side is also different and the markings readily distinguishable.

*IOLAUS COTTONI*, sp. n. (Plate IX. fig. 14.)

♂. Primaries brilliant metallic lustrous greenish blue, extending over the cell and two-thirds of the radial area below vein 4 and the entire lower portion of the wing. Costa broadly black, apex black to the cell; termen tapering rapidly to vein 2. Secondaries entirely brilliant greenish blue like the primary, with almost linear black termen, apex with black very restricted, a large black shiny sexual patch to over the cell. Fringes snow-white.—*Under side*. Both wings white. Primaries with apex broadly grey, rapidly tapering to vein 1 *a*, a short interrupted linear line from vein 6 to 3, with the white of the wing broadly edging it outwardly. Secondaries with a linear blackish subterminal line (interrupted at the veins) from the costa to the inner margin, angled as usual between veins 1 and 2; a defined small blood-red spot between veins 2 and 3; lobe-spot black, quite small, edged externally with bronzy metallic green and above with a small blood-red patch, over the lower part of which are superimposed pale metallic-blue scales; three shortish tails, the third little more than a tooth.

Expanse 38 mm.

*Hab.* Makala, Beni, Congo Free State: July.

Type in the Powell-Cotton collection.

*IOLAUS BILINEATA*, sp. n.

♀. Primaries brown, with three-quarters of the fold and the cell and the angle between veins 2 and 4 whitish, suffused more or less with very pale metallic blue, the outer part having less suffusion. Secondaries brownish, with the basal two-thirds suffused with very pale metallic blue; a white subterminal stripe bisecting the broad brown termen, a vermilion anal spot, and a black marginal spot with slight metallic-bluish scales.—*Under side*. Both wings white. Primaries with a defined brown ex-curved postmedial stripe, very slightly waved between each vein,

but not broken; a similar, much broader, but less-defined subterminal stripe from about vein 8 or 9; apical half of terminal area suffused with brownish to the postmedial line, tornal half suffused nearly to the subterminal line. Secondaries with a similar brown postmedial stripe as in the primaries, but interrupted above the vermilion patch; subterminal line yellowish brown to the vermilion patch; a dark suffused shading precedes the termen; a largish patch of bright red (almost vermilion) from above vein 3 into the lobe, with a black spot below vein 3, edged above with a dash of brilliant metallic pale blue, a similar dash extending to the lobe, a small black spot in the lobe; three tails, that at the lobe being the shortest.

Expanse 34 mm.

*Hab.* Makala, Congo Free State: March.

Type in the Powell-Cotton collection.

The measurement of this species may not be normal; it is in poor condition and slightly shrivelled, the left secondary being much smaller than the right.

#### POWELLANA, gen. nov.

Palpi with second segment scaled smoothly and somewhat swollen, reaching well above the vertex; third segment longish, fine, smoothly scaled; eyes smooth; antennæ tapering very gradually into a very fine club.—*Neuration.* Primaries with vein 2 a third from the angle, 3 from well before the angle, 4 from the lower angle, 5 from above the middle of the discocellulars, 6 from the upper angle, 7, 8, and 9 forked, 8 near apex, 9 well beyond the middle, 10 and 11 stalked from a short stalk from the cell. Secondaries with vein 2 from beyond the middle, 3 and 4 from the lower angle, 5 from well above the middle, 7 from a third before the angle. Wings ample. Primaries: costa strongly but evenly arched; termen evenly curved. Secondaries subtriangular; termen evenly arched; apex angled, anal angle somewhat acute.

Type, *Powellana cottoni* B.-B.

#### POWELLANA COTTONI, sp. n. (Plate IX. fig. 13.)

♂. Both wings cobalt-blue. Primaries with apex broadly black, extending slightly into the costa; termen very broadly blackish, invading the blue in a slight inward curve, tapering very little at the tornus. Secondaries with costa broadish black, termen less broadly black, fold grey from vein 1. Fringes whitish in both wings.—*Under side.* Both wings with broad zebra-like stripes alternating sublustrous white and olive-brown with fine linear subterminal lines; termen finely brown. Primaries with the final zebra stripe in the postmedial area met at right angles below the apex by a horizontal stripe from the middle of the costa, over which is a short similar dash; a double curved subterminal brown line, parallel with the termen, touches the

angle just referred to. Secondaries with a curved subterminal line as in the primaries, but double only between veins 4 and 6.

Expanse 44 mm.

*Hab.* Makala, Congo Free State: June.

In the Powell-Cotton collection.

The under side of this species at once separates it from all others.

*LEPTOMYRINA MAKALA*, sp. n.

Both wings dark brownish grey. Primaries with one or two ocellated spots at the tornus, the pupil blackish, the iris creamy. Secondaries with two similar spots at the anal angle and above them a terminal stripe margined on each side by a fine creamy line interrupted at the veins, a second fine creamy line nearer the cell also interrupted.—*Under side* warm stone-grey. Primaries with cell closed by a pale brownish dash with white centre, above and beyond this two small brown costal spots; postmedial stripe brown edged with white, broken slightly below vein 4; subterminal line brown, white-edged, curved inversely to the postmedial line, with a black spot in the tornus. Secondaries with a pale brownish dash closing the cell with a white centre, above it below the costal vein and nearer the base a twin spot, another spot at about the centre of the costa; on the inner margin a spot below the cell-spot; a very interrupted postmedial line strongly fractured below vein 4; subterminal line slightly interrupted and excurved, another indefinite line beyond it, a black spot between veins 2 and 3 and another at the lobe, both edged above with orange-yellow. A long brown tail edged with white.

Expanse 29–31 mm.

*Hab.* Makala, Congo Free State.

In my collection and in that of Major Powell-Cotton.

*HYPOCISTA AROA*, sp. n. (Plate IX. fig. 3.)

♂. Both wings sooty-brown with white areas. Primaries with the central two-thirds of inner margin and fold white extending obliquely to vein 4, above which the white disappears in vapoury smoky-brown. Secondaries almost sooty-black with extreme base brown; the antemedial, medial, and postmedial areas pure white, invading the broad blackish subterminal margin in an acute angle between veins 4 and 5; an oval deep black subterminal spot between veins 2 and 4 with two minute white pupils, the upper one smaller than the lower.—*Under side*. Primaries similar to the upper side, but the white area more defined. Secondaries similar to the upper side, but the white area more restricted and the black oval spot ringed with yellowish, then finely with black, and again more broadly with silvery; a similar smaller round spot at the upper apex; termen with a broad silvery line.

Expanse 44 mm.

*Hab.* Aroa River, British New Guinea.

Type in my collection.

## THAUMAINA, gen. nov.

Palpi: second segment long, haired, reaching above vertex; third segment moderately long, almost naked; antennae short, reaching only just beyond the middle of the costa. Eyes hairy.

*Neuration.* Primaries: vein 2 from about a third before the lower angle, 3 from well before the angle, 4 from the angle, 5 from about the middle of the discocellulars, 6 and 7 from the upper angle, the latter ending on the costa just in front of the apex, 8 stalked with 7 near costa, 9 absent, 10 from the cell, 11 rising rapidly to 12 and lying along it nearly all its length, but not anastomosing. Secondaries: 2 from well before the angle, 3 and 4 from the angle, 5 from above the middle of the discocellulars, 7 from just in front of the angle.

Type, *Thaumaina uranothauma* B.-B.

THAUMAINA URANTHAUMA, sp. n. (Plate IX. figs. 8 ♂, 9 ♀.)

♂. Both wings blackish. Primaries with the basal two-thirds brightish blue, the blue occupying the lower half of the cell only. Secondaries with the under side white, showing through on the costa and as a spot beyond the cell. Fringes tessellated white and black.—*Under side.* Both wings white with ocellated spots. Primaries with a black costal L-shaped mark at the base, a black dash at the centre of the costa, a subterminal irregular row of brownish-grey spots encircled narrowly with blackish; directly outside this row is a strongly scalloped pale brownish-grey line. Secondaries largely filled with confluent blackish spots, an irregular smallish black patch at the base; three spots across the middle of the wing, the first and third with white pupils, the second at the end of the cell more or less greyish; two black ringed spots with white pupils on the costa in front of the apex; a subterminal row of six black confluent spots rising on vein 6, the first four slightly curved, the fifth and sixth shifted right inwards, not entirely fractured, but coming just below the three spots across the middle; termen beyond these spots pale greyish brown, with small white spots on the termen.

♀. Like the male, but with the blue of the upper surface replaced by white and with a small whitish costal patch before the apex and a white spot below it.

Expanse 27 mm.

*Hab.* Angabunga River, British New Guinea.

Type in the Tring Museum.

CYANIRIS OWGARRA, sp. n. (Plate VIII. fig. 17.)

♂. Both wings pale slightly lustrous sky-blue. Primaries with a trace of white in the angle of veins 3 and 4; termen rather narrowly black, tapering slightly towards the tornus. Secondaries with the costa grey to the cell and vein 6; termen very narrowly black.—*Under side.* Both wings greyish white with pale liver-brown markings. Primaries with cell closed by a

slightly angled dash; postmedian line spotted, the costal spot shifted well inwards, all the spots interrupted at the veins, followed closely by the subterminal line of curved internervular dashes; termen very finely linear, preceded by a row of brownish dots. Secondaries with a basal series of three points; a small spot just outside this series in the middle of the cell, with another below it on the inner margin; cell closed by a fine line; a post-medial irregular series of spots, the costal one the darkest, the second shifted inwards, third and fourth well outwards, with a fifth small one below, sixth shifted inwards, seventh slightly angled outwards; subterminal line fine, scalloped, internervular small spots lying in the scallops; termen finely linear.

♀ with a subovate white patch in the primaries in the radial area; apical and terminal areas very broadly black nearly up to the white patch. Secondaries with the termen narrowly black, preceded by a row of internervular small black spots. Under side like the male.

Expanse 30 mm.

*Hab.* Owgara and Angabunga River, British New Guinea.

Type in my collection, other specimens in the Tring Museum.

CYANIRIS DRUCEI B.-B. (Plate VIII. fig. 16.)

♀. Both wings lustrous silvery blue, the primaries more metallic than the secondaries. Primaries with the costa very broadly and uniformly black to half over the cell; apical area and termen yet more broadly black. Secondaries with costa greyish brown over the cell and below vein 6, a row of subterminal round small black spots. Under side like the male, as described by me in the Ann. & Mag. Nat. Hist. ser. 7, vol. xvii. p. 102 (1906).

This female is in the Tring Museum, from the Angabunga River, B. N. Guinea.

CYANIRIS ACESINA B.-B. (Plate VIII. fig. 10.)

♀. Both wings pale sublustrous blue. Primaries with the costa broadly black; termen rather broader black. Secondaries with the costa sooty grey to over vein 7; termen with a row of internervular black spots. Under side like the male as described, *l.c.* p. 103.

In the Tring Museum from the Angabunga River, B. N. Guinea.

CYANIRIS BIAGI, sp. n. (Plate VIII. fig. 11.)

♂. Both wings pale violet-blue, with very fine linear brown termen.—*Under side.* Both wings silvery greyish white. Primaries with the cell closed by a yellowish dash; postmedian line yellowish, twice broken, the first spot detached well inwards as also the bottom spot below vein 3, the middle portion between veins 6 and 3 straight and confluent, subterminal row of yellowish scallops; termen with pale yellowish internervular dashes. Secondaries with three subbasal yellowish dots, the middle one in the cell shifted outwards, another dot on the inner



margin nearly below the yellowish dash closing the cell; post-medial row of spots broken at vein 6, the third, fourth, and fifth nearly confluent and shifted well outwards, seventh well inwards and isolated, eighth outwards; subterminal line scalloped, followed by a row of internervular dots.

Expanse 34 mm.

*Hab.* Biagi, 5000 ft., B. N. Guinea.

Type in my collection.

#### UPOLAMPES, gen. nov.

Palpi roughly scaled; end segment smooth, perfect, not upturned, second segment not as long as up to the vertex. Eyes hairy.—*Neuration*. Primaries: vein 2 from just beyond the middle of the cell, 3 from well in front of the angle, 4 from the angle, 5 from above the middle of the discocellulars, 6 from the upper angle, 7 and 8 absent, 9 from the cell, 10 from the cell, 11 anastomosing very shortly with 12. Secondaries with vein 2 from near the middle of the cell, 3 from just before the angle, 4 from the angle, 5 from above the middle, 7 from well before the upper angle. Primaries with costa strongly arched, termen boldly curved. Wings broad. Secondaries evenly rounded, of moderate size.

Type, *Upolampes striata* B.-B.

#### UPOLAMPES STRIATA, sp. n. (Plate IX, fig. 15.)

Both wings dull purple, with a subdued but strong metallic lustre; termen in each wing broadly blackish, rather indefinite. The under-surface markings show dimly through.—*Under side*. Both wings white, with oblique broad brown bands. Primaries with a very oblique subbasal band; medial band broad, but rather less oblique; postmedial band almost spotted, less oblique, again slightly broken at vein 7, a subterminal row of scalloped spots; termen with fine white dashes in the scallops just mentioned. The postmedial band has a trace of a pale internal band. Secondaries with the same bands as in the primaries, but the postmedial one is entirely broken at vein 6 and it has a distinct whitish internal jagged line. Cell closed by a brown dash.

Expanse 30 mm.

*Hab.* Aroa River, 4000-5000 ft.: June.

Type in the Tring Museum.

#### CALLECTITA, gen. nov.

Palpi with second segment fringed with long hair reaching above the vertex, third segment shortish, smoothly scaled; frons thickly haired; eyes densely hairy; antennae reaching beyond the middle of costa, ending in a gradually tapered club.—*Neuration*. Primaries with vein 2 from a third in front of the lower angle, 3 from well in front of the angle, 4 from the angle, 5 from the middle of the discocellulars, 6 from the upper angle, 7 and 8

stalked on a long stalk from just in front of angle, 9 absent, 10 from the cell, 11 rising rapidly to 12 and shortly anastomosing with it. Secondaries with vein 2 from well before the lower angle, 3 and 4 on a short stalk from the angle, 5 from about the middle of the discocellulars, 7 from just before the upper angle.

Type, *Callictita cyara*, B.-B.

*CALLICTITA CYARA*, sp. n. (Plate VIII. fig. 1.)

♂. Primaries very dark brown, with a large subovate black median patch whose edges are shot with purplish blue: this spot is composed of differently placed scales, as in the African genus *Uranothauma* Btl., only in a different position, and I should expect it to be sexual. Fringes brown. Secondaries white, slightly creamy, with a very broad blackish costa and somewhat less broad blackish termen, base very restricted black. Fringes tessellated black and white.—*Under side*. Both wings white with brown markings. Primaries with base brown except for a white costal dash, a broad outwardly oblique irregular median band, a broadish postmedial band to vein 2 curved and slightly tapering; termen very broadly brown. Secondaries with base and inner margin brown, the base having, as it were, two sharply rectangular steps in it, inner margin obscurely marked with whitish; termen broadly but irregularly brown, with a black marginal spot between veins 2 and 3 and at the angle edged above with metallic blue, a short tail at vein 2. An isolated quadrangular spot in the middle of the costa.

Expanse 30 mm.

*Hab.* Owgarra; Angabunga River, 6000 feet.

Type in my collection, other specimens in the Tring Museum.

I have a single specimen from Owgarra; but there is a series from the Angabunga River, a small tributary of the larger St. Joseph River.

MAMBARA, gen. nov.

Palpi upturned, second segment thickly scaled, with long hairs, tapering shorter to the third segment, reaching above the vertex, third segment smoothly scaled, longish; antennae reaching to beyond the centre of costa, not long, terminating in a club. Head and frons thickly haired; eyes hairy. Legs smooth, mid tibiae with a short pencil of hairs on the inner side at the femoral joint. Wings—Primaries with costa strongly arched, termen slightly rounded at apex, and tornus almost excavated between veins 3 and 6. Wings broad. Secondaries with termen straight from below vein 7 to vein 4.—*Neuration*. Primaries with vein 2 from beyond the middle of the cell, 3 from just before the lower angle, 4 from the lower angle, 5 from above the middle of the discocellulars, 6 and 7 on a very short stalk from the upper angle in the male; in the female 6 from the angle, 7 from the cell, 8 stalked from 7 from near the apex, 9 and 10 absent, 11 with a minute bar to 12. Secondaries with vein 2 from beyond the cell, 3 and 4 from the

angle, 5 from above the middle, 6 and 7 from the upper angle; in the female vein 7 rises from the cell, not from the angle.

Type, *Mambara nigropunctata* B.-B.

*MAMBARA NIGROPUNCTATA*, sp. n. (Plate VIII. fig. 5.)

♂. Both wings white, with restricted black bases. Primaries with a black spot closing the cell, costa narrowly black; apex and termen to vein 1 very broadly black, the black apical area reaching nearly to the cell and to the middle of the costa, with a deep indentation between veins 3 and 4. Secondaries with the black spots of the under side showing through and a black terminal short dash at vein 2.—*Under side*. Primaries white, with a basal black spot, a large oblong spot at the end of the cell, a very broad irregular angled black band from just beyond the middle of the costa to the termen, the radial and terminal areas being black between veins 5 and 2; apical area white with a small black apical spot. Secondaries creamy white, with a sub-basal round black spot between vein 8 and the cell, below which is a three-armed basal mark (remining one of the Manx Arms); postmedial stripe black, very interrupted, consisting of a costal apical spot with a broadish dash below it shifted inwards, and a small black spot below it, a black crescent shifted outwards, a spot below it in the angle of vein 3, and further in another spot in the angle of vein 2, below which shifted slightly outwards is a broad dash to the middle of the inner margin, a black spot below on this margin, and a black spot on the termen between veins 2 and 3.

♀ like the male; but in the primaries the basal black patch extends nearly all over the cell, and is confluent with the apical area, whilst in the secondaries there is a slight subterminal brownish dusted indefinite line.

Expanse 30 mm.

*Hab.* Biagi, 5000 ft., January; Owgarra.

Types in my collection, other specimens in the Tring Museum.

*CANDALIDES MARIA*, sp. n.

♂. Both wings uniform dull mauve-blue, with fine black linear costa and termen, and white fringes.—*Under side*. Both wings pure shining white, with fine linear pale ochreous-brown markings. Primaries with a twice-broken postmedial line, the middle part between veins 2 and 6 shifted outwards, a subterminal line composed of fine internervular dashes; termen very fine, linear, brown; secondaries with four basal points below each other, a larger point below the angle of vein 2, a fine dash above the angle of vein 7; the postmedial line broken as in the primaries, but the middle part shifted further out; subterminal line connected throughout, a very fine brown linear termen, a black spot at the angle, and termen finely spotted to vein 6.

Expanse 40 mm.

*Hab.* Aroa River, October.

Type in my collection.

## CANDALIDES NEURAPACUNA, sp. n. (Plate IX. fig. 10.)

♂. Both wings sooty black, with sublustrous blue areas. Primaries with the blue area occupying the cell to the inner margin and a good half of the radial area, the base of veins 2, 3, and 4 thickened, and the white of the under side showing through slightly along the fold and the basal half of the internervular spaces of veins 2 to 4. Secondaries with the blue area very subdued and suffused with fine black irrorations, occupying the cell and about half the radial area to vein 2.—*Under side*. Both wings silvery white with pale brown markings. Primaries with a fine dash closing the cell; a postmedial line of >-shaped marks interrupted at the veins, a subterminal line of fine internervular dashes, a terminal obscure row of fine points. Secondaries with a basal row of four dots, an antemedial row of three dots above which is a short erect costal dash. Cell closed by a fine dash; a postmedial row of internervular >-shaped marks, a subterminal row of fine similar marks, a terminal row of dark dots.

Expanse 40 mm.

*Hab.* Angabunga River, 6000 ft.

Type in Tring Museum.

## CANDALIDES GRANDISSIMA, nom. nov. (Plate VIII. fig. 15.)

Mr. Grose Smith has already described a species of *Holochila* (Rhop. Exot., Lyc. Orient. p. 14, pl. xviii.) under the name *grandis*; therefore my species *C. grandis* requires a new name as *Candalides* and *Holochila* are synonymous. I propose, therefore, the name *grandissima*. In Meek's collection from the Angabunga River is a series of males and one female, which latter I now describe. Both wings brownish black. Primaries with base blackish, the lower part of the cell, the median part of the fold, and half the radial area from just above vein 4 white. Secondaries brown rather than black, with the cell and slightly below it, and half the radial area above vein 4 to 7 white.

## CANDALIDES GLORIOSA, sp. n. (Plate VIII. fig. 3.)

♂. Both wings most brilliant metallic lustrous bright cobalt-blue. Primaries with apex broadly black, tapering rapidly to the tornus; costa black to the costal vein. Secondaries with costa above vein 6 brownish, termen narrowly black.—*Under side*. Both wings spotless silvery white. Secondaries with a trace of obscure black internervular terminal points.

♀. Both wings dark brown. Primaries with half the cell to the inner margin and half the radial area below vein 4 bright lustrous pale blue, with the white under side showing through in the radial area between veins 2 and 4. Secondaries with a very slight suffusion of blue in the cell and beyond and slightly below it.—*Under side*. Both wings uniform spotless shining cream-colour, with black internervular terminal dashes.

Expanse, ♂ 41, ♀ 39 mm.

*Hab.* Angabunga River.

Type, ♂ in my collection, ♀ in the Tring Museum.

## CANDALIDES AROA, sp. n. (Plate VIII. fig. 7.)

♀. Both wings blackish, with pale metallic-blue areas. Primaries with the blue area occupying the lower half of the cell to the inner margin and half of the radial area to about vein 4. Secondaries with the blue area confined to the cell to vein 1 *a*, and occupying the greater part of the radial area to about vein 6.—*Under side*. Uniform creamy spotless whitish. In the secondaries there are dark short dashes at the end of the veins.

Expanse 36 mm.

*Hab.* Aroa River.

Type in my collection.

In shape this species should be a male, as both the wings are of the normal shape of that sex; the fore tarsi, however, together with the very restricted blue areas, show it to be a female.

## CANDALIDES PRATTI, sp. n. (Plate VIII. fig. 13.)

♂. Both wings bright metallic purplish blue. Primaries with a linear black costa; termen narrowly black, increasing somewhat at the apex. Secondaries with costa white to vein 7, termen finely black; fringes white, finely black at the veins.—*Under side*. Both wings pure white, spotless except that the secondaries have a black dot above vein 1.

Expanse 33 mm.

*Hab.* Fak-Fak, Dutch New Guinea.

Type in my collection.

## CANDALIDES DINAWA, sp. n. (Plate VIII. fig. 2.)

♂. Both wings rich metallic purplish. Primaries with a broad brown apex rapidly tapering both on the costa and the termen; termen narrowly brown below vein 2. Secondaries with costa pale brown to vein 7; termen narrowly black.—*Under side*. Both wings spotless slightly shining white, except that in the secondaries there is a small black spot above vein 1, and the termen is distinctly spotted with black at the end of the veins.

♀. Both wings brown. Primaries with a metallic bluish suffusion along the basal third of the fold and slightly above vein 1 *a*, and a good-sized white patch below the end of the cell, and for about the third of the internervular space between veins 3 and 4, and nearly half the space between 2 and 3. Secondaries uniform pale brown with scalloped termen. *Under side* exactly as the male.

Expanse, ♂ 31, ♀ 28 mm.

*Hab.* Dinawa, July and August.

Types in my collection.

## CANDALIDES CYANA, sp. n. (Plate VIII. fig. 8.)

♂. Both wings bright lustrous pale sky-blue. Primaries with the costa evenly black to just over the upper margin of the cell; termen broadly black, tapering slightly to the tornus.

Secondaries with costa dark brown to the cell and well over vein 7, termen broadish black, abdominal fold sooty grey. Fringes whitish.—*Under side*. Both wings shining pearly white; the secondaries with a black dot above vein 1, the end of veins 1 b, 2, 3, and 4 spotted with black.

Expanse 36 mm.

*Hab.* Owgarru.

Type in my collection.

CANDALIDES UNIPUNCTATA, sp. n. (Plate VIII. fig. 14.)

Both wings black, with a large white patch in each. Primaries with half the cell to the inner margin and about half the radial area to vein 5 white, with a very slight dusting of fine very pale greenish-blue metallic scales at the base and in the cell. Secondaries with the upper quarter of the cell to the costa and the upper radial area from vein 4 to near the apex in an increasing curve white, with a very slight very pale greenish-blue metallic dusting in the cell. Fringes tessellated white and black.—*Under side*. Both wings white, with a broadish indefinite darkly dusted termen. Primaries with termen rather broader than secondaries, cell closed by a narrow dark dash. Secondaries with a good-sized black oval spot closing the cell, and a black dot above vein 1.

Expanse 30 mm.

*Hab.* Biagi, 5000 ft., and Angabunga River, 6000 ft.

Type in my collection; another specimen in the Tring Museum. The specimen in the Tring Museum has the metallic scaling as a slight iridescence all over the white area of the primaries, and prominently in the cell of the secondaries.

CANDALIDES ANGABUNGA, sp. n. (Plate IX. fig. 5.)

♀. Both wings dull violet-blue, slightly lustrous. Primaries with costa broadly black and apex black to the end of the cell; termen very broadly black, tapering but slightly to the tornus. Secondaries with costa and termen broadly blackish, the latter tapering slightly narrower to the tornus.—*Under side*. Both wings white, slightly shining. Primaries with a small black spot beyond the middle of the cell, termen dotted with black at the veins. Secondaries with a black spot beyond the middle of the cell, and a black dot above vein 1; termen dotted with black at the veins.

Expanse 31 mm.

*Hab.* Angabunga River, 6000 ft.

Type in the Tring Museum.

This is a peculiar species, from the shape of the wings it might be thought to be a male; but the fore tarsi are fully developed, and therefore we must regard it as a female.

THYSONOTIS ROSSELANA, sp. n.

♂. Both wings dull slightly lustrous violet-blue. Primaries with costa and termen linear black, and the white of the under

side showing slightly through. Secondaries with costa broadly white, termen narrowly black; tail very fine, white-tipped; white of under side showing through; abdominal fold white for the basal half.—*Under side*. Primaries white with costa uniformly very broadly brown extending over nearly half of the cell, termen moderately narrow brown; a dash of brown from the tornus to vein 3 separated from the termen by a narrow white line. Secondaries white, with a broad basal oblique band to the costal vein; costa wholly white except the extreme base, which is dusted with metallic blue; a broad irregular deep black postmedial band edging the brilliant metallic pale blue terminal area, which is very broad at the anal angle, tapering in an even curve to the apex and having a central row of black spots, close at the angle itself almost obsolete; termen finely white, preceded by a fine black line. Fringe blackish.

Expanse 36 mm.

*Hab.* Rossel Island.

Type in my collection.

Near *T. luculicæ* G. Smith.

THYSONOTIS EKEIKEI, sp. n. (Plate IX. fig. 1.)

♂. Both wings uniform mauve-blue, with termen narrowly black and costa to primaries linear black, the white of the under side showing through but slightly.—*Under side*. Both wings sooty brown with white areas. Primaries with base, the whole of the cell, and costa to below vein 6 sooty brown; termen broadly black, narrower between veins 3 and 5, the dark termen being broadest at the tornus; rest of internal area white nearly to the angle of vein 2. A slight stripe of metallic grey dusting along the upper margin of the cell and slightly over the margin. Secondaries with base dark sooty brown to nearly half the cell, with a short basal metallic-grey curved stripe; terminal third dark sooty brown, with a terminal row of large deep black velvety spots tapering smaller to the apex, and edged internally with metallic-green scallops and externally by a metallic-blue fine irregular line; the middle part of the wing white, occupying the middle third of the inner margin, and expanding outwards to the costa to near the apex. Without a tail.

Expanse 36 mm.

*Hab.* Ekeikei, January and February.

Type in my collection.

Near *T. endocia*, H. H. D.

THYSONOTIS ALBOSTRIGATA, sp. n. (Plate IX. fig. 11.)

♂. Both wings brilliant metallic lavender-blue with linear black margins. Primaries showing the white of the under side very slightly through. Secondaries with a broad shining white irregular median band. Tail fine, tipped with white.—*Under side*. Primaries blackish, with the white area restricted to rather

over half of the radial area up to vein 5, extending just into the lower part of the end of the cell and to just beyond the angle of vein 2 to the inner margin; a brilliant metallic pale blue costal stripe for about half the costa. Secondaries deep black, with a pure white stripe as on the upper side; base up to this black, with a brilliant metallic pale blue curved costal stripe; the terminal three-fifths black, with a terminal row of large brilliant metallic pale blue oblong spots tapering smaller to the apex, with large deep black similar-shaped pupils tapering in like manner; no white terminal fine line.

Expanse 44 mm.

*Hab.* Fak-Fak, Dutch New Guinea.

Type in my collection.

WAIGEUM DINAWA, sp. n. (Plate IX. fig. 2.)

♂. Both wings brown, with white submedian patches and metallic-blue dusting. Primaries with the white area restricted to a fair-sized somewhat oblique patch at a quarter from the base of the inner margin, occupying the middle area of the wing up to about vein 4, not extending into the cell and for about half the radial area, surrounded very broadly by brown except at the centre of the inner margin; this brown ground-colour is superimposed broadly around the white with brilliant metallic-blue fine irrorations. Secondaries with brown base extremely restricted and covered with similar brilliant blue fine dusting as in the primaries, a broad oblique white band; the outer half of the wing brown, with brilliant blue dusting in a triangular patch from the base of vein 2 to about vein 4 and halfway to the termen.—*Under side.* Primaries black, with the white area more extended than above, reaching the base below the cell, and invading the broad blackish terminal area along veins 2, 3, and 4, so as to strongly scallop it; costa with a broad band of brilliant metallic bluish-green dusting extending into the subapical area in a short curve, an interrupted terminal bluish-green similar line, and a similar stripe in the cell. Secondaries with the black base edged laterally by a broadish metallic-blue, curved, costal dash, and a fine line on its outer edge; terminal half blackish, with a subterminal row of large deep black subtriangular spots, tapering smaller to the apex, and margined entirely by the same brilliant blue dusting, which dusting tapers rather narrower towards the apex.

Expanse 42 mm.

*Hab.* Dinawa, August and September, 4000 feet.

Type in my collection.

This species will stand near *T. corruscans*, G. Smith.

WAIGEUM RESPLENDENS, sp. n. (Plate IX. fig. 12.)

♀. Both wings brown, with white areas. Primaries with the white area from the base below the cell to just beyond the centre



of the inner margin and extending just over vein 4 for about half of the radial area; a slight dusting of metallic-blue scales in the cell, especially along the lower margin. Secondaries with base brown, most restricted, and with a few metallic-blue scales; a broad white band across the medial area, more than half of the posterior part of the wing being uniformly brown.—*Under side*. Primaries with the white area occupying a similar area as above, but more restricted; the rest of the wing brown, with the costa very broadly dusted with resplendent metallic greenish-blue fine scales, extending round the subapical area in a curve, and recurved upwards internally so as to margin the apex of the white patch; a broadish terminal line of very metallic blue. Secondaries with black base margined with the same resplendent greenish-blue scales broadly above, narrowly below; white area as above, the rest of the wing blackish, edged on its internal edge narrowly with the greenish-blue scales; a very broad internal band of resplendent scales tapering slightly towards each end, in which is a row of small black spots; a subterminal broad line uniform in width of resplendent metallic greenish blue.

Expanse 42 mm.

*Hab.* Aru Island, June.

Type in my collection.

#### EXPLANATION OF THE PLATES.

##### PLATE VIII.

- |                                   |                                    |
|-----------------------------------|------------------------------------|
| Fig.                              | Fig.                               |
| 1. <i>Callictita cyara</i> .      | 10. <i>Cyaniris acesina</i> .      |
| 2. <i>Candalides dinaeva</i> .    | 11. " <i>biagi</i> .               |
| 3. " <i>gloriosa</i> .            | *12. <i>Epitola albomaculata</i> . |
| *4. <i>Paraduba ovgarra</i> .     | 13. <i>Candalides pratti</i> .     |
| 5. <i>Mambaya nigropunctata</i> . | 14. " <i>unipunctata</i> .         |
| *6. <i>Epitola mangoënsis</i> .   | 15. " <i>grandissima</i> .         |
| 7. <i>Candalides aroa</i> .       | 16. <i>Cyaniris drucei</i> .       |
| 8. " <i>cyana</i> .               | 17. " <i>ovgarra</i> .             |
| *9. " <i>sublutea</i> .           | *18. <i>Myrina sharpei</i> .       |

I have taken this opportunity of figuring some little-known species described by myself which are not mentioned in the text; they are marked with a \*.

##### PLATE IX.

- |  |   |
|--|---|
| Fig.                                       | Fig.  |
| 1. <i>Thysonotis ekeikei</i> , sp. n.      | 9. <i>Thaumaia uranothauma</i> , sp. n. ♂.  |
| 2. <i>Waigeum dinaeva</i> , sp. n.         | 10. <i>Candalides neurapacuna</i> , sp. n.  |
| 3. <i>Hypocista aroa</i> , sp. n.          | 11. <i>Thysonotis albostrigata</i> , sp. n. |
| 4. <i>Deudoryx makala</i> , sp. n.         | 12. <i>Waigeum resplendens</i> , sp. n.     |
| 5. <i>Candalides angabunga</i> , sp. n.    | 13. <i>Powellana cottoni</i> , sp. n.       |
| 6. <i>Deudoryx eleatodes</i> , sp. n.      | 14. <i>Iolans cottoni</i> , sp. n.          |
| 7. " <i>ituri</i> , sp. n.                 | 15. <i>Upolampes striata</i> , sp. n.       |
| 8. <i>Thaumaia uranothauma</i> , sp. n. ♂. |   |

March 3, 1908.

G. A. BOULENGER, Esq., F.R.S., Vice-President,  
in the Chair.

The Secretary exhibited for comparison the tail of a young lion in which a caudal claw is known to occur, and read the following communication from Mr. R. Trimen, F.R.S., F.L.S., F.Z.S. :—

“ My cat (pale grey with ordinary narrow black stripes much broken up into short streaks and spots) presents the remarkable peculiarity of a long spur or claw-like horny excrescence at the very tip of its tail. This appendage is firmly seated quite at the extremity of the last vertebra; its base appears to be expanded, and is covered all round by an elevation of the skin. It projects posteriorly in the line of the tail, is rather slender, gradually tapering, almost straight for about two-thirds of its length, and thence moderately curved downward to its moderately acute tip. In length it is nearly 7 lines, and more than a third projects beyond the surrounding fur. The colour of this spine or spur is dull reddish-brown varied with dull ochry-yellowish, here and there crossed by some broken, thin, whitish lines.

“ The cat in question is a female, small, but rather thick in body; the limbs are all rather short and the feet small, but the tail is noticeably long and broad with long dense fur. I am informed by the donor that it was born at Witney, near Oxford, and is now between seven and eight months old. I have endeavoured, with the kind aid of the donor, to ascertain from the original possessor of the animal whether any kitten of the same litter, or the mother, or other known relation, exhibited the peculiar appendage or any traces of it; but without success.

“ I may add that I have found the cat unexpectedly sensitive to any handling of the caudal claw, however gentle; she first endeavours to jerk her tail away, then gives a mild vocal remonstrance, and if the handling is continued employs her paws to stop it.”

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The Secretary exhibited some skins of the Coypu\*, *Myocastor coypu*, kindly lent him for the purpose by Mr. C. Hawkins, and called attention to the dorso-lateral position of the five pairs of teats in the female, and remarked that the position of the mammary glands in the Coypu had been recorded by Sir Richard Owen, but appeared to have escaped notice in most recent text-books.

Mr. O. Thomas, F.R.S., F.Z.S., added that the dorso-lateral position of the mammary glands was not invariably associated with aquatic habit; and Mr. E. G. B. Meade-Waldo stated, from personal observation, that the young of the Coypu swam alongside the mother and were not carried on her back, as Owen had supposed.

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\* See also P. Z. S. 1835, p. 182, for a similar exhibition by Mr. Christy.

Mr. F. E. Beddard, M.A., F.R.S., exhibited the colon and rectum of a Badger (*Meles meles*), and made the following remarks:—

The specimen of this Carnivore exhibited to-night shows a remarkably large Peyer's patch in the colon which extends through the greater part of that section of the gut and actually measures eleven inches in length. The accompanying drawing (text-fig. 17) shows the general aspect of this large agminated gland and its proportions, as compared with the gut wherein it lies. At the anterior end of the colon it is of somewhat less diameter than that which it attains later and retains until its disappearance about six inches in front of the anus. It ends here abruptly by a straight margin. Its diameter is about one third of that of the gut, and is fairly even throughout except as already stated at the commencement. More accurate measurements of this patch and of the gut are as follows: anteriorly the gut is 26 mm. in circumference and the patch is 6 mm. across; more towards the anus the gut is rather wider, measuring 30 mm., and the patch has correspondingly increased in width, being here of a diameter of 11 mm.

A close examination of the walls of the gut shows that there is no differentiation of the lining membrane, and therefore the whole piece cut out of the body and displayed in the drawing (text-fig. 17) is referable to the large intestine. These "Glandulae agminatae" are by no means recorded here for the first time as occurring beyond the small intestine in a mammal. It would appear that the first description of these structures as occurring in the colon is due to Owen\*, who found them in the genus *Macropus*. Subsequently the late Dr. Dobson† found such Peyer's patches in a variety of Rodentia and Insectivora and even in the Edentate *Manis*. This author quoted my own discovery of the same patches in the Lemur, *Haplolemur griseus*, which I subsequently figured‡. Miall and Greenwood record the same glands in their treatise upon the Elephant; and all of these sources of information, with the exception of my own observations upon *Haplolemur*, are to be found referred to in the monumental work of Oppel§.

It is, however, not only the situation of this Peyer's patch in the large intestine that is of interest. Its size also is remarkable; but it is by no means unique in this particular. For Oppel observes that "Beim Rind findet man am Ende des Rektums eine 2-3 M. lange Platte die noch in das Caecum hineinreicht." There is also a large Peyer's patch in the sheep and the pig and in one or two other animals belonging to the same order as *Meles*, viz., in the cat and the dog. This large patch in the Badger would seem to be quite as large as in the other mammals which possess a similar patch.

P.S. (added June 10th).—In a second specimen (half-grown),

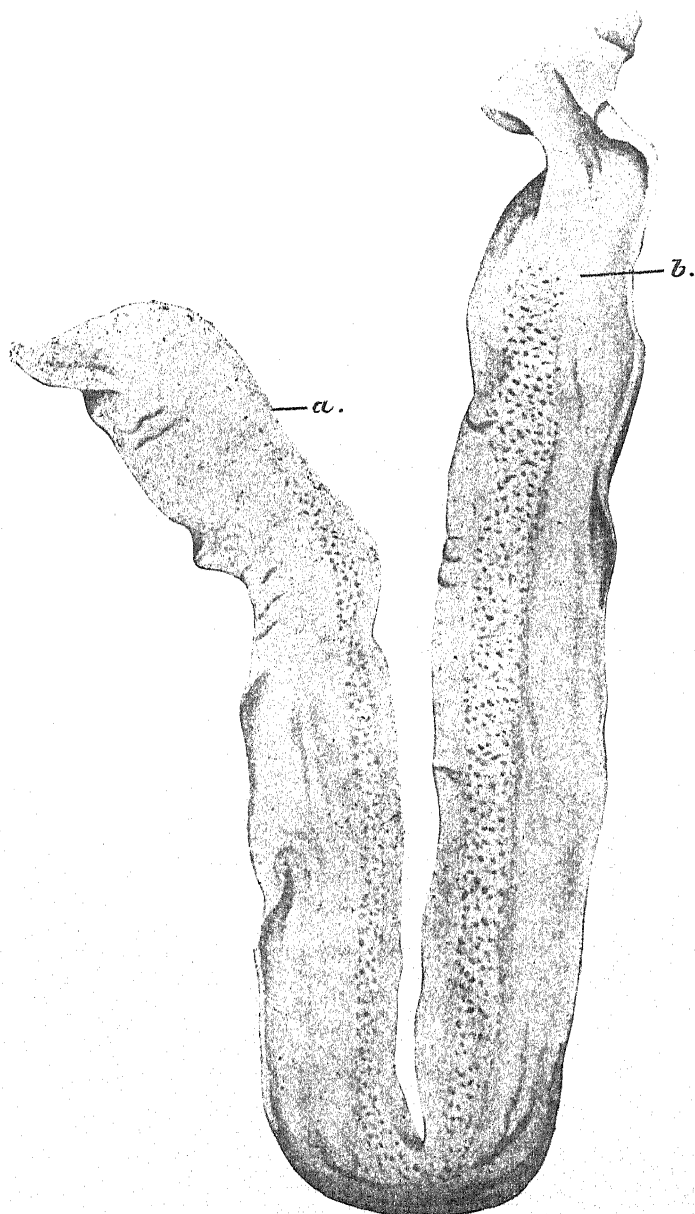
\* Article "Marsupials" in Todd's Cyclopaedia, and in his treatise on Comparative Anatomy, 1868.

† Journ. Anat. Phys. xviii. 1884, p. 388.

‡ P. Z. S. 1891, p. 453, fig. 2.

§ Lehrbuch der Vergleichenden Mikroskopische Anatomie, Teil ii., Jena 1897.

Text-fig. 17.



Colon of Badger (*Meles meles*) cut open to show Peyer's patch (about nat. size).  
*a, b*, commencement and termination of patch.

examined on May 5th last, there was no trace of this Peyer's patch, which may therefore be a character of full maturity. Both specimens have been sent to the Royal College of Surgeons.

The following papers were read : --

1. On a young Female Kordofan Giraffe. By P. CHALMERS MITCHELL, M.A., D.Sc., LL.D., F.R.S., Secretary to the Society.

[Received February 17, 1908.]

(Text-figures 18-20.)

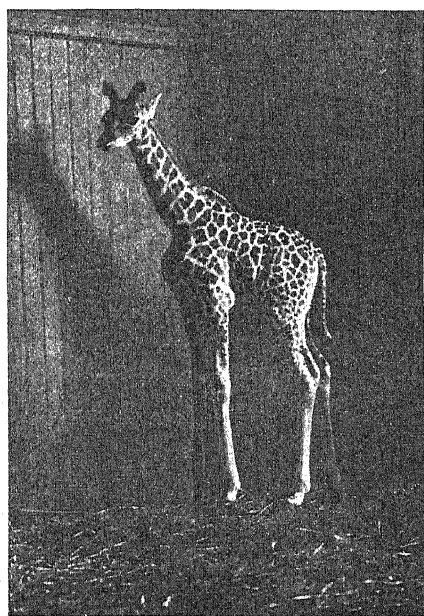
The female of the pair of Kordofan Giraffes (*Giraffa cameloopardalis antiquorum*) presented to the Society by Col. B. Mahon, F.Z.S., in 1902, gave birth to a female calf on Sept. 20th, 1907. There are so many interesting differences in the coloration of Giraffes, which have been employed by Mr. Lydekker (P. Z. S. 1904, p. 202) in his valuable attempt to discriminate subspecies, that I think it is worth while to publish some notes and figures on a young form, the parentage of which is known, and which seems to have a good prospect of reaching maturity in the Society's Gardens. The drawings from which text-figs. 19 & 20 have been reproduced were made when the Giraffe was about eight weeks old, being the work of a very careful artist, Mr. Goodchild, who had already made similar drawings of the young Nigerian Giraffe, reproduced with some notes I prepared in the 'Proceedings' of the Society (P. Z. S. 1905, p. 244).

A photograph taken by Mr. W. P. Dando, F.Z.S., when the young Giraffe was a few days old, is reproduced in text-fig. 18. For the general proportions of the body it is interesting to compare it with the figure of a Giraffe foetus published by Mr. Beddard (P. Z. S. 1906, p. 626, text-fig. 107) and with the photograph of the young female Nigerian Giraffe about a year old published in my own paper (P. Z. S. 1905, text-fig. 50). The neck is relatively longer in the new-born calf than in the foetus, but not so long in proportion as in the year-old specimen, although in the latter it had not nearly attained the excessive proportions of the adult. The long neck of the Giraffe, therefore, is a character that appears late in ontogeny, as, no doubt, it appeared late in phylogeny.

The frontal horns are well-formed, divergent, large, and covered at the extremities with very long tufts of hair. Here, however, is an instance where phylogeny and ontogeny cannot be regarded as parallel. It is difficult to suppose that the horn-shaped skin protuberance was developed in the past history of Giraffes before the bony core, and yet at birth the core was very much shorter than the skin protuberance with its tuft of hair, so that the "horns" could lie almost flat against the head.

The colouring and pattern of the skin was well marked in the new-born Giraffe, the general appearance being a slightly closer approach to the reticulate type than to the blotched type of its parents, the edges of the dark fawn-coloured patches being sharper, and the white reticulum being brighter and better defined. As in the parents, the front of the face is fawn-colour, the colour extending more widely than in the Nubian and Nigerian Giraffes, there being only a rim of white round the eyes; whilst in the other two forms, and especially in that from Nigeria, the facial fawn-colour is a relatively narrow band, leaving the sides of the

Text-fig. 18.



Female Kordofan Giraffe about one week old.

face pale. There is a dark spot between the nostrils similar to that present when the Nigerian Giraffe was younger, but which in the latter is not now noticeable. The sides of the face have fawn-coloured patches, larger and more numerous than in the Nigerian form (text-figs. 19 & 20). The parallel wrinkles on the face, to which Sir Ray Lankester recently directed attention (P. Z. S. 1907, p. 115 and text-figs. 42 & 43), are similar to those in the parents. Sir Ray Lankester informs me that, in examining the Giraffe in question a few days after birth, he thought there were traces

visible of a set of parallel stripes on the forehead between the horns and the eyes, similar to those figured by him on a coloured drawing of the foetal Giraffe (P. Z. S. 1907, pl. v.). No doubt these are ephemeral, for neither Mr. Goodchild nor I could detect their presence a few weeks later. The interior of the ears shows dark markings arranged in three distinct pencillings.

Text-fig. 19.

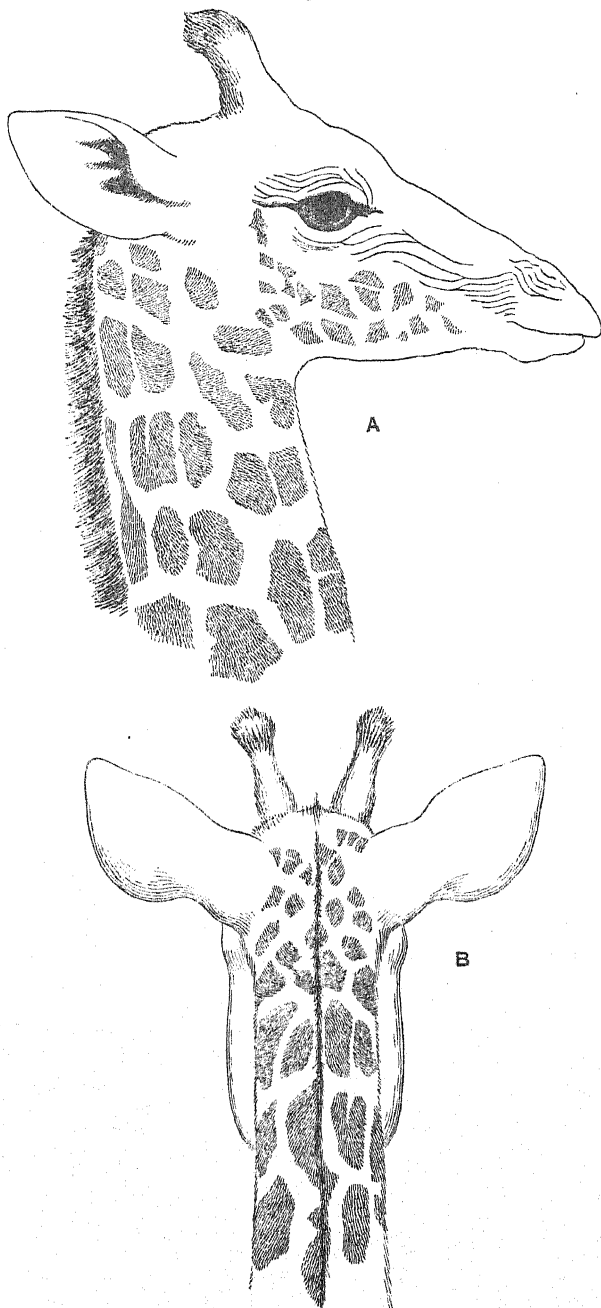


Head of Kordofan Giraffe calf.

The coloured patches on the back of the neck (text-fig. 20, B) in the region just between and below the ears resemble those of the parents, and differ markedly from those in the corresponding region in the Nigerian Giraffe. As Mr. Lydekker first pointed out, and as I was able to confirm from another example, the Nigerian Giraffe in that region has the broad large series of blotches extending up almost to the level of the insertion of the ears, whilst in all other Giraffes a set of much smaller spots extends considerably lower down.

The white patch which extends round the front of the throat

Text-fig. 20.



Head of Kordofan Giraffe calf.—A. Side view. B. Back view.



in the adult, appearing as if a white muffler were tied round the neck to the roots of the ears and forming a most conspicuous pattern in both the parents of this young Giraffe, is present, but is much less conspicuous.

Along the length of the neck, and especially in front, the large blotches are much more quadrangular, relatively larger, and more closely set together than in either the parents or the female Nigerian Giraffe. Those on the dorso-lateral areas of the neck are also more numerous and more closely set together than in the parents or in the Nigerian Giraffe, and are markedly asymmetrical on the two sides.

On the sides of the body the blotches of the young Kordofan Giraffe resemble those of its parents in being rather more numerous and irregular and relatively smaller than in either the Nubian Giraffe (*G. c. typica*) or the Nigerian form. I cannot quite follow Mr. Lydekker, however, in the stress he lays on the coloration of the upper parts of the limbs. He states (*loc. cit.* p. 206) that the Kordofan Giraffe is "easily distinguishable" from the Nubian form by the "circumstance that in the fore-limb from just above the line of the abdomen, and on the hind-limb halfway up the thigh, the spots suddenly break up into a series of very small spots of irregular size and shape, similar spots occurring on the underparts and inner sides of the limbs." The inner sides of the limbs and the underparts have small spots as in the parents, and it is just possible to describe the existence of a sudden change in the size of the spots on the hind-limb, but hardly so in the case of the fore-limb; whilst in these respects it is quite impossible to separate the young Kordofan Giraffe from the young female Nigerian form. I notice, moreover, that in the female Nubian Giraffe, of which Mr. Lydekker gave a coloured plate (*loc. cit.* pl. x.), there is a nearly sudden change in the spots. The lower parts of the legs are nearly colourless, as in the parents and in the Nubian and Nigerian forms.

This young Giraffe then, on the whole, conforms with its parents in the characters selected by Mr. Lydekker as distinctive of the Kordofan race, but certainly does not furnish additional evidence for the discrimination. It will be interesting to see if as it grows it comes to assume these characters more definitely. Whilst at first sight it resembles the young Nigerian female, a close comparison shows that in general tone it is a darker animal with more numerous, smaller, and more closely-set spots, and that it agrees with its parents, and does not agree with the Nigerian form, in the characters separating the Kordofan and Nigerian Giraffes.

2. A Comparison of the Neotropical Species of *Corallus*, *C. cookii*, with *C. madagascariensis*; and on some Points in the Anatomy of *Corallus caninus*. By FRANK E. BEDDARD, M.A., F.R.S., Prosector to the Society.

[Received February 7, 1908.]

(Text-figures 21-27.)

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(1) A COMPARISON OF *CORALLUS COOKII* AND  
*C. MADAGASCARIENSIS*.

Some little time since\* I contributed to the 'Proceedings' of this Society notes upon the visceral anatomy of the Madagascar Tree-Boa, *Corallus madagascariensis*. This particular species is the only one out of five or six species which inhabits Madagascar. The rest are all Neotropical in habitat. The distribution of this genus *Corallus* is therefore remarkably like that of the allied genus *Boa*, of which there are also both Neotropical and Madagascar species. This very remarkable distribution renders it particularly desirable to scrutinise carefully the structure of the species of these two genera, which inhabit two such mutually distant regions of the world. It is possible that both these instances may prove to be parallel to the case of *Solenodon* and *Centetes*, which were at one time thought to be more nearly allied than systematists are now inclined to allow, and I shall give reasons for believing that the two species of *Corallus* are different in structure. Dr. Gadow observes† that *Boa dumerili* and *Boa madagascariensis*, "both of Madagascar, cannot be separated from the genus *Boa*." Mr. Boulenger, in the British Museum Catalogue of Serpents‡, places *Corallus madagascariensis* alone in a special subdivision of the genus on account of the comparative length of its tail; but he is unable to find in external characters any features of sufficient weight to justify its generic separation from the remaining serpents placed by him and by others in the same genus. I am able in the present communication to lay some facts before the Society which bear upon this matter; and, as I have had the opportunity during the past year of dissecting no less than seven examples of an American species, *Corallus cookii*, I am able to say something about the variations shown in the anatomy of this snake; the fact that I have been able to check

\* "Contributions to the Knowledge of the Vascular System, &c., in Ophidia," P. Z. S. 1906, p. 516.

† Cambridge Nat. Hist. vol. viii. Amph. & Rept. p. 602.

‡ Catalogue of Snakes, vol. i. p. 99.

my observations by the dissection of so many examples allows perhaps of a more reliable comparison of the two species, though it must be remembered that I only dissected one example of *Corallus madagascariensis*.

The seven examples of *Corallus cookii* which I have dissected were of different sizes and show among themselves a certain amount of variability in structure which will be dealt with in the following pages. For the convenience of reference, in the course of my remarks I shall refer to them as Specimen A, B, &c. Their lengths were as follows (the lengths given, it should be observed, are of the body proper, that is to the cloacal aperture. I did not trouble to measure the tail):—

A. ♀ 64 inches. B. ♂ 63 inches. C. ♂ 48½ inches. D. ♂ 71 inches. E. ♂ 65 inches. F. 64 inches. G. 53 inches.

Of the last two examples I did not ascertain the sex. I shall now deal with certain organs and systems seriatim.

#### § *External Characters.*

In distinguishing the various species of *Corallus* the one from the other in his Catalogue, Mr. Boulenger makes use of a large number of characters, but does not avail himself of the number of scales which border the mental groove. This character happens to be of some use in the determination of the two species with which I deal in the present communication. I ought to say, first of all, that a faint doubt hangs over the identification of specimen A. In this individual I did not ascertain definitely that it belonged to the species *Corallus cookii* by counting the number of scales in the rows upon the body. I do not think, however, that there is really much danger of a mistake having been made in its identification; for in every other character which I examined it agreed broadly with the other individuals in which I did carefully count these scales. The numbers quite agreed with the figures given in his Catalogue by Mr. Boulenger. As to the scales which border the mental groove, I found in *Corallus madagascariensis* that the number on each side was eight. In *Corallus cookii* there are not less than nine and not more than eleven of these scales on each side, the prevailing number being ten. There is thus a difference, though doubtless a slight one, between the two species. The greater length of the mental groove in *Corallus cookii* gets perhaps some additional significance as a character of value from the fact that there is precisely the same difference, as I have already recorded\*, between the two species of Anaconda, viz., *Eunectes murinus* and *E. notatus*. In the former there are seven scales on each side and in the latter only five. The same kind of difference also distinguishes two species of the genus *Boa*; for in one individual of *Boa divinitoqua* (a male) the mental groove was very short indeed and bordered only by two scales on either side,

\* P. Z. S. 1906, p. 15.

while in another example (a female) by one scale only; whereas in its close ally, *Boa constrictor*, I found in one individual three scales on either side of the mental groove. I may take this opportunity of mentioning that I found in three examples of the Boid *Enygrus carinatus* five or six scales on each side of this groove. The number of scales bordering the chin-groove, although apparently useful in discriminating species, does not help in the division of the Boidæ into the two groups Pythoninæ and Boinæ; for in *Python spilotes* I found seven scales on one side and eight on the other side of the groove, and in *P. regius* four on each side. In examples of *Python seba* and *P. molurus* there were eight of these scales on each side.

As to the *anal claws*, I have unfortunately no observations upon these in *Corallus madagascariensis*; but in *Corallus cookii* they were present and similar in both sexes, being sharp and curved. Each was ensheathed in two or occasionally three bract-like scales, which were situated on the concave side of the claw. In this latter feature *Corallus* appears to agree rather with *Eunectes* than with *Boa*; for in the latter genus the claws are ensheathed (in both sexes of *Eunectes notens*) by two scales, while in both *Boa constrictor* and *B. divinitoqua* the female snake possesses a small sharp claw which does not appear to be ensheathed.

### § Lungs.

Although, as I shall take occasion to point out immediately, the lungs of *Corallus cookii* present certain variations in structure in the individuals of that species, they all agree to differ from those of *Corallus madagascariensis* in one important particular. The latter species on the whole resembles the genus *Boa*, in that the bronchus of the larger of the two lungs extends for a long way into its interior as a shallow gutter; in fact, to a point beyond the commencement of the liver. I may take this opportunity of recording the fact that in *Eryx conicus*\*, a representative of a genus undoubtedly belonging to the Boinæ as contrasted with the Pythonine section, the larger lung is also provided with a very long intrapulmonary bronchus. I have found the same in the Indian *Eryx johni*. In an individual of the former snake I found that the bronchus was continued down to a point corresponding with certainly the end of the first third of the liver, and that it reached the region of the lung, where it ceased to be vascular. In this snake I noticed a further peculiarity in this bronchial gutter: the "gutter" itself was of course in free communication with the interior of the lung, as the word used to describe it implies; but, in addition to this, a series of small perforations, quite numerous and regularly arranged in pairs, put the cavity of the gutter into communication with that part of the lung which was covered over by the semirings of the bronchial

\* In Cuvier's 'Leçons d'Anatomie Comparée,' ed. 2, t. vii. 1840, p. 137, the same is stated of "*Erix turcicus*" (= *Eryx jaculus*).

gutter. The exact disposition of the bronchus and its relations with the lung requires further study in these animals. In all Pythons, on the other hand, which have been examined from this point of view, the lungs agree with each other to differ from those of *Boa*, *Eryx*, and *Corallus madagascariensis* in the shortness of the intrapulmonary bronchus. This varying disposition of the bronchus would appear therefore to be of generic value at least in some Boidæ; it becomes therefore a matter of some importance to note that in *Corallus cookii* the conditions observable in *Corallus madagascariensis* are not repeated, but that the intrapulmonary bronchus of the former snake is short.

Thus the two snakes, although belonging, in the opinion of many, to the same genus, show a point of difference in the structure of the lungs which in other Boidæ is at least of generic value. In *Corallus madagascariensis* there is not, as it would appear, any trace of the tracheal lung. In *Corallus cookii*, on the other hand, the extension forward of the soft tissues of the lung between the separated ends of the semirings of the trachea is, for a short distance, invaded by lung-tissue. The cellular arrangement is quite visible. It is not uncommon among snakes for the semirings of the bronchus to be continued upon the lung as a fibrous seam, which seems to mark a shrinkage of the bronchus itself; this is the case with the lung of *Corallus madagascariensis*. It must be borne in mind that this seam is not a structure differing in any essential from the internal walls of the lung. It is simply produced by a coincidence in direction of the walls of a number of lung-alveoli. That there is this coincidence, and in a longitudinal direction immediately following upon the end of the intrapulmonary bronchus, would seem to indicate the gradual obliteration of a formerly more extensive intrapulmonary bronchus. The shrinkage of this through narrowing and finally obliteration would, in my opinion, leave a straight line with pulmonary alveoli on each side, the alveoli being in consequence symmetrically arranged. This is, at any rate, a possible explanation of the phenomenon.

Another view might be held which will be explained directly. While *Corallus madagascariensis* is characterised by the possession

#### Explanation of Text-figs. 21 & 22 (opposite).

Text-fig. 21.—Larger lung of *Corallus cookii* cut open to display the entrance therinto of the trachea.

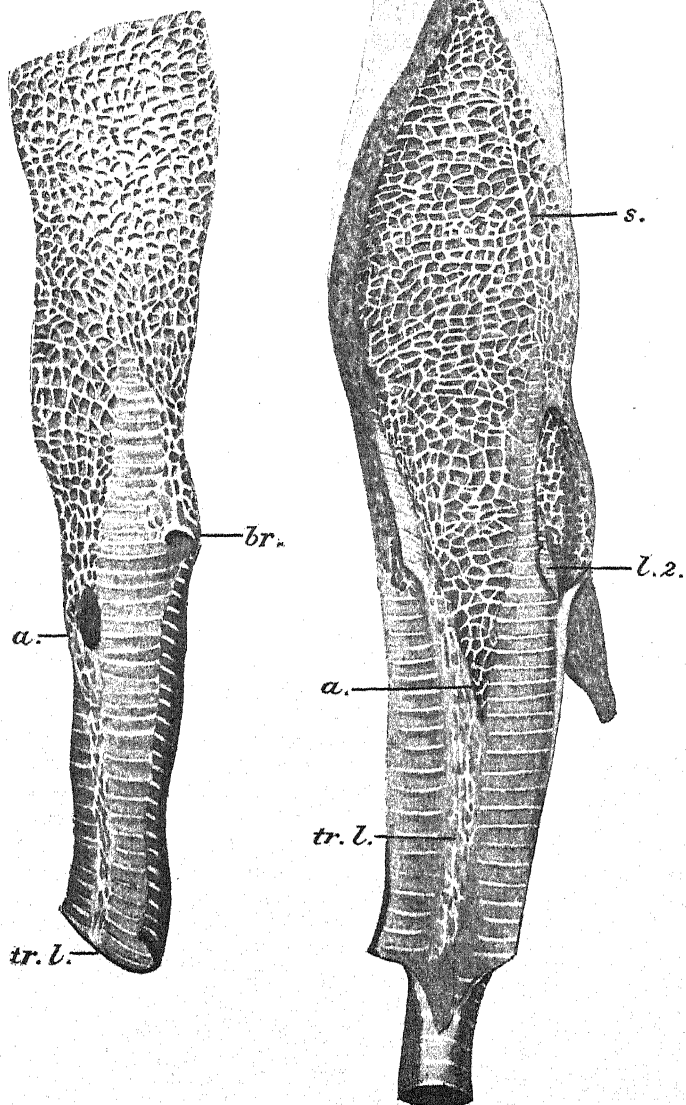
a. Forward extension of the lung lying dorsally to the trachea. br. Aperture of bronchus of smaller lung. tr.l. Tracheal lung.

Text-fig. 22.—The larger lung of another example of *Corallus cookii*, to be compared with that represented in text-fig. 21.

a. Forward caecal extension of larger lung. 1, 2. Smaller lung, below which is seen its forward caecal extension projecting to right of trachea. s. "Seam" running along lung. tr.l. Tracheal lung.

Text-fig. 22.

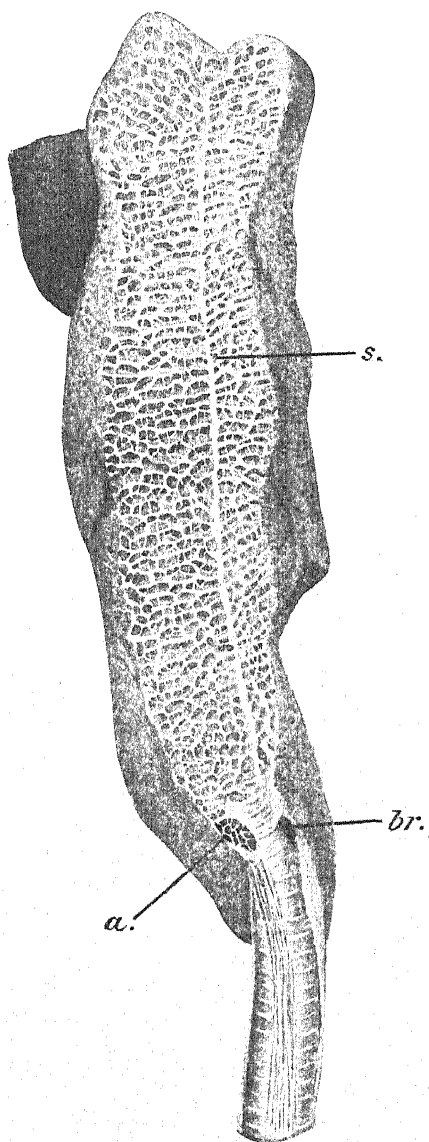
Text-fig. 21.



of this seam running down the lungs for some distance after the intrapulmonary bronchus has ceased as a series of cartilaginous bars, *Corallus cookii* has at most a small representative of this seam, which appears to be in some specimens actually absent. There is thus in any case a difference between the two species. It is necessary, however, to describe in greater detail the condition of the lungs in the specimens which I have dissected. In specimen A there was no seam at all; in B and D there was a distinct seam; in E, F, and G, I could find no seam. Of C, I have no observation upon the point. It would appear therefore that in *Corallus cookii* the seam is at least beginning to disappear, while there is no evidence that that is the case with *C. madagascariensis*, though the latter data being based upon one specimen are obviously not so secure.

The variations in the lungs of *Corallus cookii* do not, however, stop with the presence or absence of the longitudinal seam. The accompanying figures (text-figs. 21 & 22, p. 139) illustrate the anterior end of the lung in two individuals of *Corallus cookii*, and I have had drawn for comparison with them a corresponding portion of the lung of *Python spilotes*, in which snake there is a very conspicuous seam continuing the bronchus down the lung (text-fig. 23). There is, however, in *Python* no vestige of a tracheal lung and the intrapulmonary bronchus is quite short. The lungs of *Corallus cookii* figured are from the specimens D and E; one shows a seam and the other does not. Although in the lung which was removed from specimen E there was certainly not the faintest trace of a seam to be noted when the lung was examined in a fresh condition, appearances indicative of such a seam were to be seen in that lung after it had lain for some little time in a solution of formol. It occurred to me therefore, on a re-examination of the lung after it had been thus prepared, that some error must have crept into my notes. The matter is of obvious systematic importance, as will be pointed out later on in connection with the variation of another organ (the gall-bladder), and so a careful study of the lung was made. I found that the appearance of a seam in this lung was in truth only an appearance; in fact, a contraction produced by the formol had manifested itself along the line of junction of the two lungs, and here it was that the seam appeared. But on pulling apart the surfaces of the lung the "seam" was observed to disappear at once and to be therefore not a permanent structure, but merely a wrinkle produced by the contraction due to the formol. On the other hand, no amount of pulling apart would obliterate the real seam of the second lung figured, that of specimen D. Here, therefore, was a real seam, a permanent structure. It is possible, however, that these appearances, due to contraction, may be an indication of how the seam really arose in the first place. A contraction along the line of fusion of the right and left lungs might possibly become permanent in the course of generations. With regard to the seam, it is noteworthy and quite apparent in the figure that it did not begin immediately

Text-fig. 23.



Larger lung of *Python spilotes*, for comparison with text-figs. 21 & 22.

The commencement of the liver is shown to the left of the figure.

Lettering as in text-figs. 21 & 22.



with the cessation of the intrapulmonary bronchus\*. It is first visible at some little distance beyond this point and extends back only for an inch or so. In comparing the larger lung in these two examples of *Corallus cookii*, another important difference will be apparent from the figures. The larger individual measured 71 inches, it will be remembered, from snout to cloacal orifice, the smaller 65 inches. The difference in length between these serpents is not therefore very large; one might fairly speak of them as being about the same size. It will, however, be noted from the accompanying figures, which are drawn to the same scale, that the lung of one of the examples is very much larger than that of the other, the difference being much more pronounced than would perhaps be expected in two snakes so nearly of the same length. It would, I should think, be imagined by anyone examining the drawings referred to, that one snake was half the size of the other. One would hardly expect to find any difference in the size of the lungs in the two individuals; and yet there is the difference described and figured. As I have contrasted the lungs not only in these two individuals but in two others, F and G, measuring respectively 64 and 53 inches, and which both possess small lungs like those of specimen E, I can venture to draw the conclusion that the lungs do certainly vary considerably in capacity within the limits of this single species. Furthermore, the tract of bronchus which lies within the lung is by no means equal in the two specimens (D and E). In the one with the smaller lung there were, so far as I could count, 16 bronchial semirings belonging to the intrapulmonary bronchus, and the length of the intrapulmonary bronchus was 17 mm. In the snake which had the larger lung there were certainly three or four more semirings, and these rings were distinctly narrower than in the other specimen, where their breadth from side to side was clearly greater. The intrapulmonary bronchus of the larger specimen measured 31 mm. In specimens F and G the intrapulmonary bronchus measured respectively 11 and 10 mm. In specimen B, the only other one of those in which I identified the presence of a seam at or near the end of the intrapulmonary bronchus, I have a note that the intrapulmonary bronchus is at least 25 mm. long. There is thus a considerable variability also in the intrapulmonary bronchus; but it will be observed that the variations in the lung tend to arrange themselves into two series. In the one the intrapulmonary bronchus is long and a seam is present; in the other the bronchus in the same region is short and there is no seam. These facts seem to point to two stages in the disappearance of the intrapulmonary bronchus.

#### § Arterial System.

The arterial system, so far as I have examined it, also shows

\* I find in a newly born *Eunectes notatus* a similar gap between the end of the bronchus and the beginning of the seam.

differences between the two species of *Corallus* with which I am concerned in the present communication; and the difference is rather remarkable in that it is closely paralleled among the true Pythons, as I shall point out immediately. In *Corallus cookii* the aorta gives off comparatively few intercostal branches. Yet the intervertebral spaces are served by a regularly paired series of arteries as in the Boidæ generally. The arrangement of these arteries is, in fact, like that of the Boine (as contrasted with the Pythonine) snakes, in that the few branches arising from the aorta and passing dorsally are connected together by a series of secondary longitudinal trunks; from these latter arise, at the requisite regular intervals, the actual branches which bury themselves in the intercostal spaces. This is precisely the arrangement that would have been expected in a snake belonging to the sub-family *Boinae* of the family Boidæ according to the facts which I have been able to record in various genera of that family. It is, in fact, *Corallus madagascariensis* which is thus far "abnormal," for, as I have already recorded, in that snake the disposition of the intercostal arteries is not after the Boine but the Pythonine plan. This rather unexpected state of affairs to a certain extent of course throws doubt upon the value of these characters from a classificatory point of view. I have laid some stress in former papers upon the value of the intercostal arteries in the classification of serpents; but it is at least noteworthy that the difference in structure goes hand in hand with a totally different range in space. The Old World *Corallus madagascariensis* agrees with the Old World Pythons, while the New World *Corallus cookii* agrees with the New World Boas. The parallel instance to which I have referred above is of course *Python spilotes*; this snake, while agreeing with Pythons generally in a number of features of its organisation, has a system of intercostal arteries which is not like that of the Pythons generally, but agrees with that of the *Boinae*. Here, again, the difference goes hand in hand with a difference in habitat; for *Python spilotes* belongs to the Australian region, while all the other Pythons that have been examined from this point of view are either African or Asiatic in range. It would be of the greatest interest to study some of the other members of the genus *Python* which occur in or near to the Australian region, and also the other American members of the genus *Corallus*. In the meantime I can only point out these rather anomalous facts. I may also mention that in those individuals where I looked for this artery each kidney had only one renal artery, as in Boidæ generally.

#### § Venous System.

With reference to the venous system of *Corallus* I have observations to make only concerning the umbilical and azygos veins.

The *umbilical vein* is, so far as I know from my own observations, small and rudimentary in the Pythons, but well developed

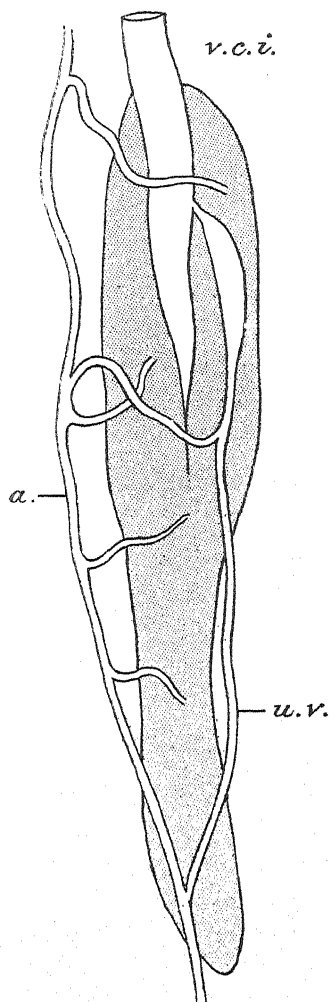
in *Boa* and *Eunectes*. I could not find this vein in *Corallus madagascariensis*. In one specimen of *Corallus cookii*, on the other hand, there is a small vein arising from the postcaval just after the commencement of the liver which I regard as probably representing that vein. It may be that I have missed it in *Corallus madagascariensis*; and yet I rather fancy that it did not occur in the specimen which I dissected, for it was naturally carefully sought for, as being of some importance in classification.

Another example happened to allow of a more accurate description of what appears to be the persistent umbilical vein, more poorly represented, or, it may be, in a poorer condition for observation in the other snake. The accompanying figure (text-fig. 24) shows this vein and its connections. Behind the liver a single epigastric vein runs along the median dorsal line in close contact with the body-wall, as in all snakes (in which it has been looked for). Passing forward, this vein divides into two, at first divergent and afterwards parallel, veins at a point about half an inch or so in front of the posterior end of the liver. The left-hand of these two veins continues to bear the characters of the epigastric vein. It emits branches to the liver, which cross over or rather under (as the animal is viewed on a dissection) the other vein. These branches enter the liver and form a part of the hepatic portal system; there are altogether five of these, the last entering the liver quite close to its anterior termination. On the other hand, the second of the two divisions of the at first single epigastric vein runs above, but gives off no branches to, the liver. This can be seen most plainly, and, as I think, is an anatomical fact—and not merely due to the vessels being invisible owing to their emptiness of blood. Close to the anterior end of the liver this vein receives a branch from the parallel epigastric vein, which runs obliquely backwards from that vein to join the parallel trunk and at this point bends downwards to reach the liver. On the surface of that organ it dilates somewhat and narrows again to be connected with the postcaval vein by at least a membranous seam in which I did not observe with certainty any blood. It may be pervious, but I am not quite determined upon the point. There are clearly reasons for looking upon this vessel as the persistent umbilical vein. If this be admitted, then it follows that in this character also the American species of the genus *Corallus* shows likenesses to the Boine rather than to the Pythonine subdivision of the Boidæ.

There is therefore in this feature also a difference between the New World and the Old World representatives of the genus *Corallus*, and, moreover, on the whole it may be said that the New World species resembles more the Boine than the Pythonine section in this particular. There is, however, by no means a close resemblance between *Corallus cookii* and the Boas in the disposition of the umbilical vein, as will be seen by a reference to my descriptions of that vein in *Boa* and *Eunectes*. That there should be differences between individuals of *Corallus cookii* is not surprising in

view of the fact that the vein is, as it would appear, a vein in course of disappearance among the Reptilia.

Text-fig. 24.



The liver and certain veins connected with it of *Corallus cookii*.

*a.*, epigastric vein; *u.v.*, umbilical vein; *v.c.v.*, postcaval vein.

On the whole the *azygos vein* appears to be a more extensive vein among the Boidæ than among the Colubrine Snakes. I have

quoted in other papers communicated to the Society facts from my dissections relative to the shortness of this vein in both of those two great divisions of the Ophidia. With regard to the Colubrine Serpents I have now two other examples to mention which bear out the view expressed above. In *Helicops angulatus* the azygos is smaller than in any snake in which I have seen it. A stoutish vein on the right side connects the parietes with the precaval, and nothing further is seen of it after the point at which it emerges from the parietes; it is not at all continued down the body. In *Heterodon nasicus* the azygos is also small, but not smaller than in some other Colubrines in which I have described it. The vein, which is, as usual, on the right side of the body, is formed by the confluence in regular order of four intercostal branches. The last of these emerges from a circular orifice in the parietes with well-marked edges of very much greater diameter than the vein which it permits to pass out. In the case of the other branches no such orifice was visible; they simply push their way between the various layers of tissue. In the Boidæ on the whole the azygos is better developed than in the non-Boine snakes, but in no Boid which I have had the opportunity of studying is that vein so continuous for so many segments as in *Corallus cookii*. I only observed this in one specimen which happened to be particularly favourable for this examination. Furthermore, the arrangement was the same on both sides of the body, and the appearance presented by these veins was therefore reminiscent of the postcardinals in the Tailed Amphibians as figured by Hochstetter\*, and as I have myself† observed. I believe that there are no embryological data as to the significance of these veins in the Boidæ, and I therefore use the term "azygos" as being in the present state of knowledge a somewhat vague term‡ with nevertheless a definite meaning of a kind §, but one which implies no homologies with other vertebrates. As I have no facts about the same veins in *Corallus madagascariensis*, and as our knowledge of this vein in the Ophidia generally is not extensive, I can make no comparisons of value except, indeed, to point out that *Corallus* is, on the whole, like other Boidæ in this respect.

#### § Liver.

*Corallus madagascariensis* showed a curious peculiarity in the structure of the liver. The posterior end of one of the lobes of that organ was enormously prolonged as a thin tail of hepatic substance. This state of affairs is merely an exaggeration of the commonly found projection of the one of the two liver-lobes posteriorly beyond the other. In *Corallus cookii* there is some

\* Morph. Jahrb., Bd. xiii. 1888, p. 119.

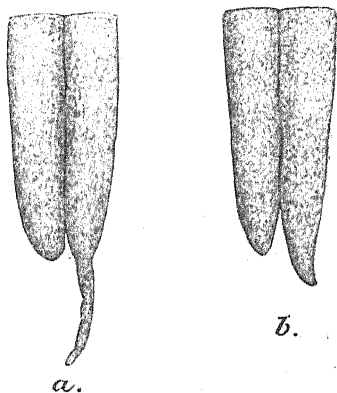
† In *Amblystoma tenebrosus*.

‡ There is not always a strict homology, as I believe, even between veins in different mammals which have been described under this name.

§ I. e., a vein which draws blood from the dorsal thoracic parietes.

variability in the form of the posterior termination of the liver (text-fig. 25), but in no specimen that I have dissected was there anything at all approaching the long thin appendage of *Corallus madagascariensis*. In one specimen, where this prolongation was particularly well developed, it only measured  $\frac{3}{4}$  of an inch in length, which is far below that of the hepatic process of its presumed congener. The prolongation, in fact, in *Corallus cookii* is hardly an exaggeration of what is found in those other serpents in which the one lobe does extend further backwards than the other.

Text-fig. 25.

Posterior end of liver of two individuals (*a* & *b*) of *Corallus cookii*.

*a* shows a long tail-like process.

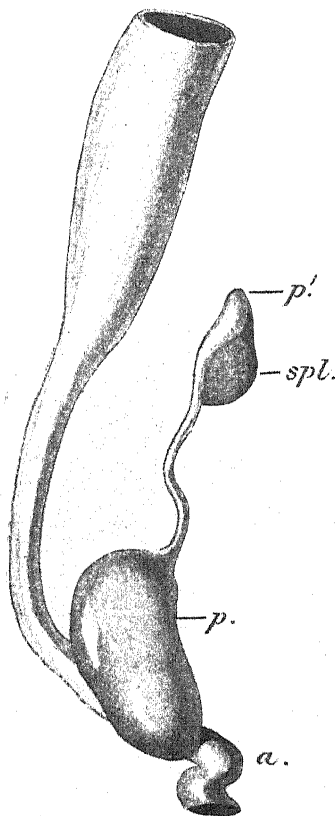
Out of the six other examples of *Corallus cookii* which I examined three had a more or less well-developed tail to the liver and three had the barest traces of the same. The two species thus contrast, it being of course assumed that the one example of *Corallus madagascariensis* which I examined represented the normal in structure.

#### § Pancreas and Spleen.

I take these two organs together, because in the Reptilia (especially in the Ophidia) there is generally a pretty close connection between them. In *Corallus madagascariensis* the spleen is a small rounded body situated at some distance from the pancreas, which is a solid compact gland abutting on to the duodenal walls. In *Corallus cookii* the pancreas is of a different form, always assuming that I have made no error in the description of *C. madagascariensis*. In any case it is certain that in *C. cookii* (for I have identified the various structures to be

described in five individuals) the pancreas (text-fig. 26) consists of a large solid piece abutting upon the duodenal walls, as in the other species of the genus with which it is here compared; but in addition to this there is a thin isthmus of pancreatic tissue connecting the major half of the gland with a round piece of pancreatic tissue closely attached to the spleen; the latter is of course

Text-fig. 26.

Pancreas and adjacent viscera of *Corallus cookii*.

*a.* Commencement of coiled region of intestine. *p.* Main mass of pancreas; *p'*., process of the same attached to spleen. *spl.* Spleen.

to be distinguished from the pancreas by its purplish colour, the pancreas being yellowish. In one example of *Corallus cookii* (specimen A) the spleen, instead of being a rounded body, is thicker at one end and tails off into a long thin process at the

other. In specimen E the spleen has traces of this peculiar form in that the rounded spleen closely attached to the nearly detached piece of the pancreas is reinforced by a splenculus situated three-quarters of an inch from it, which latter tails off into a thin process. In the other specimens the spleen is a single rounded body as I have described it in *Corallus madagascariensis*. The pancreas would appear therefore to be pretty constant in its characters in *Corallus cookii*. This form of pancreas seems to be characteristic of the family Boidæ among the Ophidia. I find in *Eryx conicus* a practically identical arrangement; so also in *Python sebae*\*. I have already described as characteristic of *Eumectes murinus*† that the pancreas is divided into two portions, of which one is apposed to the duodenal wall and the other is attached to the distantly situated spleen. The duct of the gland connects these two parts. It is possible that in that snake there is also an isthmus of pancreatic tissue lying along the duct; in any case there is certainly this isthmus in the other serpents to whose pancreas I have referred above. In *Python spilotes* much the same structure of these organs is to be seen; and, moreover, in that Python, as in *Eumectes murinus*, the spleen is reinforced by additional splenculi, seen also rarely in *Corallus cookii*. On the other hand, *Boa constrictor* differs in that the spleen is close to, but not much in contact with, a solid pancreas unprovided with any discrete fragment and connecting isthmus.

The organs in *Boa constrictor* are, in fact, constructed on the plan of those of the non-Boine snakes, where, however, the connection between spleen and pancreas is sometimes rather close. In *Vipera russelli* the smaller spleen sits like a cap upon the larger pancreas. In *Dasypeltis scabra* the two "glands" are in absolute contact, and in *Helicops angulatus* the spleen is actually imbedded in the wider distal end of the pancreas, appearing upon its surface in the form of two patches. Von Siebold and Stannius, in their well-known and usually (so far as my own experience goes) accurate and comprehensive text-book of comparative anatomy‡, do not sum up accurately the relations of the pancreas and the spleen when they write: "Die Milz ist getrennt vom Pankreas bei *Eryx*, *Python*, *Chersydrus*, nur wenig ihm anhängend bei *Boa*. Die Verbindung ist inniger bei den übrigen Schlangen." These observers would seem to have missed the process of the pancreas so common among the Boidæ. The fact that it is common in that group, and not, as it would appear, found elsewhere, has some significance. For among the Lacerilia there is very generally a long and thin process of the pancreas which comes into actual contact with, or at least gets

\* In another example of *Python sebae* the distal portion of the pancreas was completely separated from the larger duodenal portion by an actual break in the connecting isthmus, bridged only by the pancreatic duct.

† "Contributions to the Anatomy of the Ophidia," P. Z. S. 1906, p. 25.

‡ "Handbuch der Zoologie," Bd. ii. Amphibia, 1856, p. 187. It is perhaps remarkable that Cuvier and Milne-Edwards have no observations upon these points in their text-books.



very near to, the more distantly situated spleen. As the Boidæ are believed, by reason of a considerable number of anatomical peculiarities, to stand at the base of the Ophidian series, this fact is obviously not without importance.

### § *Relative Position of Viscera.*

The relative position of the viscera among snakes and their proportionate lengths are important as diagnostic characters. Thus, in the Viperine Serpents the liver follows close upon the heart, and in the Boidæ the kidneys have rather a different position from that in the case of other Ophidia. It is not, therefore, without importance to compare the two species of *Corallus* in these particulars.

	<i>C. madagascariensis.</i>	<i>C. cookii.</i>
Total length to vent .....	50 inches.	64 inches.
From symphysis of jaws to auricles of heart.....	?	18½ inches.
From apex of heart to beginning of liver .....	2½ inches.	4½ inches.
Length of liver.....	12½ inches.	11 inches.
Distance between end of liver and gall-bladder .....	½ inch.	8 inches.
Length of kidneys .....	1¾ inch.	3½ & 2½ inches.
Distance of end of posterior kidney from vent .....	About 5-6 inches.	10 inches.

It is obvious from the above measurements that there are differences between the two species, which cannot by any means be accounted for by the differences in length which they show as individuals. Thus one kidney, at any rate, of *Corallus cookii* is twice the length of that or rather those of *Corallus madagascariensis*, although the length of the snake is only one-fifth or one-sixth greater. Furthermore, the distance of the kidneys from the cloacal orifice in *C. cookii* is greater, both actually and proportionately, than in *C. madagascariensis*. This Boine character is therefore more emphasised in the American than in the Madagascar species. Although the liver of *C. madagascariensis* is slightly longer than that of the American species, this does not account for the great discrepancy which the two species show in the distance of the gall-bladder from the end of the liver. In *Corallus cookii* the two kidneys hardly overlap. The posterior kidney begins where the right kidney ends. I find that here, as in the case with *Corallus madagascariensis* and other Boidæ, the kidney of each side is furnished with only a single renal artery. This structural fact can, as I think, be now regarded as characteristic of the Boidæ as compared with many other snakes.

In view of the rather slender differences which often exist between different genera among the Ophidia, it appears to me that the differences here recorded between *Corallus madagascariensis* and *C. cookii* are worthy of receiving generic value. But for the present I do not consider the matter of a name for the Madagascar species, since there is no knowledge of the structure of the remaining American species of the genus.

The following brief statement embodies the principal anatomical characters of the two species, *Corallus madagascariensis* and *C. cookii*:—

#### **Corallus madagascariensis.**

*Mental groove bordered by eight scales on each side. Bronchus continued for a considerable distance into larger lung. Intercostal arteries regularly paired like those of Python\*.* No rudiment of umbilical vein. Liver commences closer to apex of heart, of considerable length, terminating in a very long thin posterior prolongation of one lobe. Gall-bladder close to end of liver. Pancreas with no prolongation to spleen. Kidneys short, nearer to vent.

#### **Corallus cookii.**

*Mental groove bordered by ten scales on each side. Bronchus continued only for a short distance into interior of larger lung. Intercostal arteries not regularly paired like those of Boa.* A rudiment of or a more fully-developed, umbilical vein. Liver commences further from apex of heart, of less considerable length, sometimes terminating in a short thin prolongation of one lobe. Gall-bladder at a considerable distance from end of liver. Pancreas with a prolongation to spleen. Kidneys longer, further from vent.

For the measurements made above for the purpose of contrasting the two species of *Corallus*, I was compelled to select one of the larger specimens of *Corallus cookii* dissected by myself. For though I have dissected smaller examples of the same length as the individual of *Corallus madagascariensis*, the details as to the position of the viscera were unfortunately imperfect in my notes. From such details as I have preserved, however, it would not appear that much has been lost by not being able to make a more accurate comparison between the two species of snake in these particulars. Since the examples of *Corallus cookii* which I have examined range from a length of 48½ inches to 71 inches, it becomes a matter of interest to note what, if any, alterations take place in the relative sizes of the various organs and their position with regard to each other during the process of growth. There is, furthermore, another rather important variation to be deduced from these studies, as will be apparent when the facts

\* Exc. *Python spilotes* (see above, p. 143).

have been set forth. These facts are given in the accompanying table, which is regrettably imperfect in places.

	A. (64 inch.)*	B. (63)	C. (48½)	D. (71)	E. (65)	F. (64)	G. (53)
From symphysis of jaws to auricle of heart.....	18½ †	18	14	19½	?	18	17
From apex of heart to liver ...	4½	4¼	?	5¼	?	4	?
Length of liver .....	11 ‡	11½	8	11¼	10¼	10¼	8½
From end of liver to gall-bladder .....	8	5½	5½	?	8	6½	6½
Length of kidneys .....	3½, 2½	3½, 3½	2½, 2	3½, 3	2½, 2½	?	?
From end of posterior kidney to vent .....	10	9	?	12½	12	?	?

The study of the statistics presented in the above table shows, as it would appear, only one important instance of variation between individuals. That concerns the distance at which the gall-bladder is situated from the end of the liver. In specimens A, E, F, and G, particularly in the first and second of the four, the gall-bladder is markedly more distant from the end of the liver than in the remaining examples where I have noted its position. In view of its much smaller length, specimen C should perhaps be referred to the same list. It is a fact not without interest that in specimens E, F, and G the intrapulmonary bronchus is not continued by a seam down the lung, and that the lungs are relatively small. On the other hand, in the only examples in which I ascertained the presence of a seam, viz., in B and D, one, at any rate, has a large lung, and the other shows a short interval between the end of the liver and the gall-bladder. There is thus, as I venture to maintain, a commencing differentiation of species among these externally quite similar snakes. There is a distinct tendency to the segregation of the individuals into two groups: the one with a seam down the larger lung, which is relatively of larger size than in the other individuals, and a gall-bladder comparatively far removed from the posterior end of the liver; the other with relatively smaller lungs without any seam, and the gall-bladder not so far removed from the end of the liver. Apart from these series of variations, which seem to allow of the sorting into two lots of the individuals considered, other organs vary in a less regular fashion. In the liver there

\* It will be recollected that the above measurements are taken from the top of the snout to the vent. They are set forth in inches.

† This and all the following measurements are in inches.

‡ The thin "tail" to one lobe of the liver is comprehended in these measurements, where it occurs. It does not occur in specimens D, E, G.

may or may not be a moderately long and thin posterior prolongation of one of the lobes; the intrapulmonary bronchus also is longer and shorter in some specimens than in others; the spleen is by no means entirely constant in its form in every individual. The position of the kidneys varies slightly, as does the amount of overlap of one by the other. The table showing the relative position of the different organs of the body indicates that there is, as might be expected, a correspondence between the lengths of the snakes and the distances separating the viscera. The table, however, does not show satisfactorily where the growth of the individual takes place, except that it would perhaps be inferred that it is not in the region following the liver; for in two individuals measuring respectively 63 and 48½ inches the distance from the end of the liver to the gall-bladder is precisely the same. I observed this carefully in the two individuals F and G. There is a difference of ten or eleven inches in total length between the snakes, and yet the distances between the end of the liver, the spleen, and the gall-bladder were exactly the same, as was conclusively shown by placing the snakes side by side, when the organs mentioned were seen to correspond exactly in position. This seems to show that the growth in length takes place both in front of and behind this particular region of the body. I should imagine that this region corresponds to the umbilical region of the new-born snake. In conclusion, it may be pointed out that the comparative fixity in the relative position of organs in so many specimens and of different lengths confirms the use of this character as of systematic value in snakes.

### § *Conclusions.*

It will be clear that the characteristics of these two species of *Corallus*, even if they be ultimately referred to two distinct genera, breaks down my previous attempts to define the subfamilies *Boinæ* and *Pythoninæ* by anatomical characters, and renders those characters only generally applicable. Hitherto these two subfamilies have been distinguished by the existence in the *Pythoninæ* of a supraorbital bone wedged in between the prefrontal, frontal, and postfrontal bones; this bone is wanting in the *Boinæ*. I presume that *Corallus* has been examined in this respect, and has been found to possess no supraorbital bone. Otherwise the *Boinæ* (and *Corallus cookii*) agree to differ from the *Pythoninæ* (including *Corallus madagascariensis*!) in the mode of distribution of the intercostal arteries, and in the persistence of a considerable umbilical vein. I am disposed to think that in view of facts accumulated since the division of the Boidæ as indicated above, it is not so desirable for the present to insist upon any such subdivision, which is, after all, by no means in accord with geographical range. On the other hand, the present communication enables me to substantiate still further the characteristics of the family Boidæ, which differs from all other

families of Ophidia, whose characters are well known, by the following distinguishing features:—

*Vestiges of hind limbs present. Two lungs (except in Ungalia). Bronchi entering lungs at a little distance from their anterior extremity. Aorta giving off regularly-paired intercostal arteries or regularly-paired intercostals derived from fewer branches of aorta. Renal artery single on each side (rarely two). Umbilical vein of fetus often persistent in adult to a greater or less extent. Anterior abdominal vein connected with afferent renals. Azygos usually long. Postcardinals present in front of kidneys. Pancreas usually with splenic lobe.*

These characters are, for the most part, points of likeness to the Lacertilia, which are more numerous in the Boidæ than in other snakes. They thus argue the basal position of the Boidæ in the Ophidian series—a view which is quite generally held.

## (2) SOME NOTES UPON THE ANATOMY OF *CORALLUS CANINUS*.

The comparisons instituted in the above account of the structure of *Corallus cookii* are further confirmed by the dissection of an example of *Corallus caninus*, which I have been able quite lately to examine. The specimen of this extremely beautiful species of Tree-Boa had been, as I understand, identified when alive by Mr. Boulenger. I identified it myself when dead, before learning this fact, with the help of that gentleman's 'Catalogue of the Snakes in the British Museum'\*. The catalogue in question, though allowing of an easy reference of the individual to its proper species, does not refer to what appears to me to be the most salient external character of the species when compared with its immediate ally *Corallus cookii*; that is, the much greater size of the scales in the latter species. In *Corallus cookii*, in fact, a scale upon the dorsal surface near to the middle line measured 4 mm. in length; a scale from a corresponding position in *C. caninus* measured only 2 mm. The pitting of a much greater number of the labial scales than in *C. cookii* is another character of this species. I found that in the individual examined by myself the first lower labial of one side was slightly pitted. This does not appear to be always the case. The mental groove is longer in this snake than in *C. cookii*. It is bordered by fifteen scales on each side. Thus there is an exaggeration of the characters of *C. cookii*, and not an approach towards *C. madagascariensis*. On the other hand, the short tail of *C. caninus* (the length to the cloaca was 34 inches, that of the tail  $5\frac{3}{4}$  inches) is an approach to the condition observable in *C. madagascariensis*. The anal claws were small, and, on account of their white colour, inconspicuous. Each lay between two scales in front and one behind, and the area of implantation was rather bare.

I have given reasons for regarding the position of the viscera

\* Vol. i, London, 1893, pp. 99 & 102.

within the body of serpents generally as of systematic importance. The following are the corresponding facts relating to *Corallus caninus* :—

Length of body to cloaca, 24 inches.

From snout to heart, 9 inches.

From heart to liver,  $3\frac{1}{2}$  inches.

Length of liver,  $5\frac{1}{4}$  inches.

From end of liver to gall-bladder,  $1\frac{1}{4}$  inches.

These measurements, though incomplete \*, indicate a closer agreement with *Corallus cookii* than with the Madagascar species, as will be evident from a comparison with the tables on pp. 150 & 152. At the same time, there is perhaps some approach to the latter in the comparative closeness of the end of the liver to the gall-bladder. Moreover, the liver in *Corallus caninus* has a long thin "tail," measuring no less than an inch and a half. This, again, is a slight approach to *Corallus madagascariensis*, inasmuch as the tail of the liver in both species is about one fourth of the length of the entire liver, while in *C. cookii* there is evidently a tendency for this thin posterior prolongation of the liver to disappear. This, however, is nearly the only point in the internal anatomy of *Corallus caninus* in which I have ascertained a likeness to the Madagascar species at all more pronounced than to *Corallus cookii*. In examining the liver I naturally sought with care for vestiges of the umbilical vein. These are quite obvious, and I am even inclined to think that this vein is fairly well-developed in the present species, though its condition did not permit of an accurate mapping of the course of the vein. However, a strongish vein—the further course of which along the body-wall I am unable to state—dips down from the body-wall to the liver. Arrived upon the surface of the liver its calibre becomes increased, as is often the case with the umbilical vein in the Boine snakes; but, instead of joining the postcaval, it appears to end in the liver-substance. But its former connection (?) with the postcaval is indicated by a furrow deeply marked which connects the vein with the postcaval, continuing in the same straight line as the vein would traverse were it to pass directly to the postcaval. I think, therefore, that this vein is the persistent umbilical and not merely a branch of the epigastric. I may point out that, if this opinion is well founded, the present species of *Corallus* agrees with its American congener.

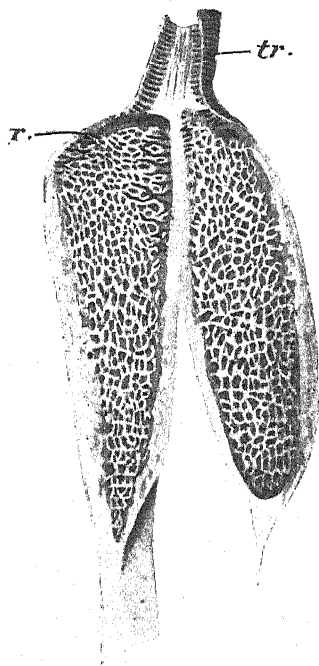
As I have already pointed out, the Madagascar and the South American species of *Corallus* differ in the relations of the pancreas to the spleen. I am bound to state that *Corallus caninus* seems to be more like *Corallus madagascariensis* than is to *Corallus cookii* in these matters. That is to say, there is no thin process of the pancreas putting the pancreas into actual contact with the anteriorly lying spleen. On the contrary, the

\* It was desirable to injure the snake as little as possible.

rounded pancreas lies upon the gut, and the small spleen lies at a considerable distance from it and is without any connection with it. The spleen is rounded, distinctly divided into two lobes, but with no tail-like process. On the whole, however, it does not appear to me that these differences have generic value. For I have pointed out precisely similar differences between the two species of *Anaconda* \*.

Two important anatomical features remain for consideration, in both of which *Corallus caninus* is more like its South American

Text-fig. 27.



Lungs of *Corallus caninus* cut open to show interior.

*tr.* Trachea. *r.* Right lung; the irregular bronchial semirings within this lung are shown on the right near to the septum between itself and the left lung.

ally. These are the arrangement of the intercostal arteries and the structure of the lungs. As to the former, *Corallus caninus* has the Boine disposition of the intercostal arteries. That is to say, there are but few of the arteries arising directly from the

\* "Contributions to the Anatomy of the Ophidia," P. Z. S. 1906, p. 25. I may add that *Eryx conicus* and *E. johani* also differ in this; for in the latter there is no "tail" to the pancreas. As to the former see above, p. 149.

aorta; but these few bifurcate and trifurcate, and from secondary longitudinal connections arise the actual intercostals. This is obviously like *Corallus cookii*.

The lungs of *Corallus caninus* are illustrated in the accompanying figure (text-fig. 27). It is obvious that they are, generally speaking, more like those of *Corallus cookii* than they are like those of the Old-World species *Corallus madagascariensis*. This is chiefly seen in the short length of the intrapulmonary bronchus. There is, however, no tracheal lung. The interannular membrane is readily to be distinguished from the tissues of the lung by its white colour and thick appearance. It has no lung-like structure; there is no appearance of alveoli. It is, therefore, fairly sharply marked off from the lung-tissue with which it is continuous. The bronchus of the larger lung descends into that lung for a distance of about 14 mm. This distance is, it will be observed, much the same as that found in the case of *Corallus cookii*. In the smaller lung the intrapulmonary bronchus is only 6 mm. long. In the case of the larger lung I counted 15 bronchial semi-rings. This, again, is about the number found in *Corallus cookii*. It is possible that here, as in *Corallus cookii*, there is some variability in the structure of the lung. But as I have only one example, I can merely point out that it agrees with one set of specimens of *Corallus cookii*. The intrapulmonary bronchus is rather broad; it was 8 or 9 mm. across in the case of the larger lung a little way down, and the intervening pulmonary tissue only 6 mm. across. It is important to notice that no trace of a seam could be detected. The intrapulmonary bronchus of this snake does not, as will be apparent from the figure referred to (text-fig. 27), form a regular gutter with a series of regular and similar annuli. On the contrary, the annuli are very irregular after the commencement, and are fused together and sometimes incomplete. They were to be distinguished by their very red colour in the example dissected. This irregularity is much more marked than in *Corallus cookii*. In describing above the lung of *Eryx*\* I have drawn attention to the series of orifices into lung-cells ranged along the sides of the bronchus and between the annuli. In the present species this condition is much more marked, and serves to distinguish the species from *Corallus cookii*. As will be seen in the figure, these orifices are numerous and scattered irregularly between various annuli. The differentiation between lung and intrapulmonary bronchus is therefore less marked in this species than in many snakes, and is by no means typically Ophidian. It recalls, in fact, very distinctly the lungs of such a reptile as *Heloderma*†.

There is a final point in the structure of the lungs of this serpent which demands attention, though it does not bear upon the main object of the present communication to the Society, viz., the relationship of the Neotropical to the Madagascar species of

\* *Supra*, p. 137.

† See Beddard, P. Z. S. 1907, p. 61, text-fig. 16.



*Corallus*. As will be observed in the figure of the lung of *Corallus caninus*, the headward running pocket of the lungs occupies a different position in the two lungs. In the case of the larger lung it will be seen that the anterior process of the lung in question is partly roofed by the interannular membrane of the trachea as well as by the bronchial semirings. On the other hand, the same anterior process of the shorter lung has no relation whatever to the interannular tracheal membrane. I do not know how far this is to be seen in other two-lunged snakes (Boidæ). I hope to look into this matter further, since it has an obvious bearing upon the degree of degeneration of the smaller lung, and therefore upon the phylogeny of the group.

The following brief statement of the anatomical characters of the species will serve for a comparison with the corresponding definitions of *C. madagascariensis* and *C. cookii* upon p. 151.

#### *Corallus caninus*.

*Mental groove bordered by 15 scales on each side. Bronchus continued only for a short distance into interior of larger lung; its rings become irregular and interrupted by orifices into lung-tissue. Intercostal arteries like those of C. cookii. A rudiment of umbilical vein persists. Liver with long posterior prolongation of hepatic substance. Gall-bladder rather near to end of liver. Pancreas with no prolongation to spleen.*

The agreement with *Corallus cookii* is obviously much closer than with *C. madagascariensis*.

### 3. Description of a new Species of Monkey of the Genus *Cercopithecus*. By R. I. Pocock, F.L.S., Superintendent of the Gardens.\*

[Received February 18, 1908.]

(Plate X.†)

The Zoological Society has recently acquired by purchase from Mr. F. C. Thorpe, of Hull, a young example of a species of *Cercopithecus* quite different from any form hitherto described. At Mr. Thorpe's special request I dedicate this new species to Mr. Ezra, of Calcutta.

#### *CERCOPITHECUS EZRÆ* Pocock.

Abstr. P. Z. S. 1908, p. 10 (March 3).

Skin of upper part of face black; that of the lips and chin blue, clothed with white hairs. Head ornamented in front with a

\* [The complete account of the new species described in this communication appears here; but as the name and the preliminary diagnosis were published in the 'Abstract,' the species is distinguished by the name being underlined.—EDITOR.]

† For description of the Plate, see p. 160.



J. Green del. et Chromo lith.

NEW SPECIES OF CERCOPITHECUS.\*



conspicuous rusty-brown brow-band like that of *C. neglectus*, but melting posteriorly into the general colour of the rest of the head, and not sharply defined by a jet-black band. The area in front of the ears slightly tinged with rufous-brown, but the rest of the head, the cheeks, neck, and dorsal and lateral surfaces of the body closely speckled greyish-yellow and black. The outer surface of the thighs and of the upper arms also similarly speckled, but, like the cheeks, rather more rufous than the body. On the shoulder and upper arm there is a lighter stripe such as is seen in *C. neglectus*, and there is a corresponding stripe on the outer side of the thigh, but this is not nearly so conspicuous as the thigh-stripe of *C. neglectus*, being of a dirty yellow and not white. The lower arms are dark brown and finely speckled externally, but not jet-black as in *C. neglectus*, whitish stained marginally with yellow on the inside. Hands and feet somewhat rubbed, scantily clothed with white hair. Tail not black, but covered with speckled hairs, resembling in tint those of the body, rufous at base. Hairs on the throat white, but not forming so long a beard as in *C. neglectus*. Chest and belly greyish with a decidedly rusty tinge. Belly and inside of the thighs white, but the hairs beneath the callosities and on the backs of the thighs not white but tinged distally with rusty red.

*Loc.* Unknown, probably Upper Congo.

This species is evidently related to *C. neglectus*, as is testified by the red-brown band, the whiteness of the lips and chin, and the presence of the pale stripe on the thigh, not to mention the corresponding stripe on the upper part of the arm and the general colour of both the upper and the under side. It might almost be briefly diagnosed as a species of *Cercopithecus* differing from *C. neglectus* in lacking the black areas characteristic of the latter. The two may be contrasted as follows:—

- a. The red area of the forehead sharply defined posteriorly by a jet-black band crossing the summit of the head from side to side; hairs beneath the callosities white; tail, with the exception of a couple of inches at its base, jet-black.
- neglectus.*
- a'. The red area on the forehead not sharply defined behind, but blending with the speckled tint of the top of the head, which has no black transverse band; hairs beneath the callosities not white but tinged with rusty yellow; tail not black, but the same colour as the back ..... *ezrae*.

Up to the present time *C. neglectus* has occupied in the genus an isolated position, and opinions as to its affinities have differed. By Drs. Selater, Forbes, and Trouessart it was associated with *C. diana* on account of the presence of a beard of longish hairs on the throat and chin, and of a white stripe on the outside of the thigh. But in the monograph of the genus *Cercopithecus* recently published by this Society (P. Z. S. 1907, pp. 677-746), I put

forward the opinion that the species must be regarded as an aberrant type of the *Leucampyge*-group (p. 685). The correctness of this view is shown by the discovery of *C. ezrae*, which may be said to occupy an intermediate position between *C. neglectus*, on the one hand, and the Abyssinian Monkey described as *C. boutourlinii*, which I consider to be a subspecies of *C. leucampyge*, on the other.

The only very young example of *C. neglectus* that I have seen—namely, one from the Cameroons—resembled the adults in colour.

It is to be regretted that the exact locality of *C. ezrae* is at present unknown, but since it came to Hull in company with an example of *C. ascanius schmidti*, its geographical area is probably the Upper Congo. The species is so distinct from even its nearest allies that there can be no difficulty, I think, in its identification when other specimens come to hand to be named.

In the P. Z. S. 1907, p. 739, I described a new species of *Cercopithecus* from the Congo under the name *nigroviridis*. Since the figure of the head of this species represented on pl. xlii. fig. 5, and taken from a dried skin, is inaccurate in two particulars, namely, in showing the chin black and in omitting the narrow black streak running back from the corner of the eye, I take this opportunity of figuring the whole animal from an example now living in the Gardens.

I also figure the type of that remarkable new species said to have come from the Ituri Forest and described by myself in Ann. Mag. Nat. Hist. (7) xx. pp. 521–522, 1907, as *Cercopithecus hamlynii*. The animal is still living in the Gardens, and owing to change of coat and improvement in condition has altered somewhat in colour. The brownish-yellow speckling of the hairs has changed to greenish-yellow. There is no pale brow-band except such as is indicated by the grey bases of the anterior hairs. The arms are for the most part black except for a speckled area below the elbow on the outside. The wrist and ankles, like the hands and feet, are black.

#### EXPLANATION OF PLATE X.

- Fig. 1. *Cercopithecus nigroviridis* Poc.
2. *Cercopithecus ezrae*, sp. n.
3. *Cercopithecus hamlynii* Poc.

(The attitudes are taken from photographs of living animals.)

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March 17, 1908.

Dr. HENRY WOODWARD, F.R.S., Vice-President,  
in the Chair.

The Secretary read the following report on the additions made to the Society's Menagerie during the month of February 1908:—

The number of registered additions to the Society's Menagerie during the month of February was 171. Of these 146 were acquired by presentation and 7 purchased, 9 were received on deposit and 9 by exchange.

The number of departures during the same period, by death and removals, was 189.

Among the additions special attention may be directed to:—

One male Orang Utan (*Simia satyrus*), from Deli, Sumatra, presented by Dr. J. C. Graham on Feb. 5th.

A male and two female Pronghorn Antelopes (*Antilocapra americana*), from North America, presented by President Roosevelt on Feb. 4th.

A Pallas's Cat (*Felis manul*), from Tibet, deposited on Feb. 29th.

A Variegated Spider-Monkey (*Ateles variegatus*), a Red Brocket (*Cariacus rufus*), and a collection of 63 Birds, including one Scarlet Cardinal (*Cardinalis phoeniceus*), four Desmarest's Green Tanagers (*Calliste desmaresti*), two Olive Saltators (*Saltator olivaceus*), and five Sonini's Colins (*Eupsychortyx sonini*), new to the Collection, from Venezuela, presented by A. Pam, Esq., F.Z.S.

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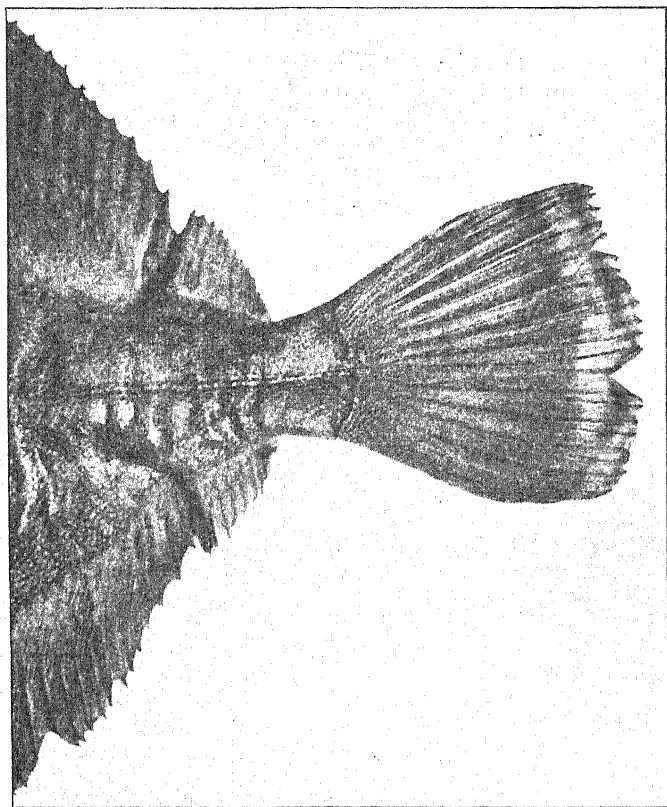
Mr. G. A. Boulenger, F.R.S., V.P.Z.S., exhibited a remarkably malformed Plaiçe (*Pleuronectes platessa*) from the London market, which had been presented by the Secretary of the Fishmongers' Company, Mr. J. Wrench-Towse, to the British Museum.

The fish measures 375 millim. from the end of the snout to the end of the caudal fin, and for the first 245 millim. of its length is perfectly normal in form, scaling, fins, and coloration. But after that a sudden change takes place. The point where the change takes place is indicated on the eyed or coloured side by a rather deep chink in the dorsal and ventral (or left and right) outlines, accompanied by a sudden rise in the length of the dorsal and anal rays, which at that point are separated by a wider membrane; after this, however, the rays gradually decrease again in length towards the caudal peduncle, which, as well as the caudal fin, is perfectly normal. There is no solution of continuity in the arrangement of the scales or in the course of the lateral line. The only other difference, on this side, from a normal specimen, is a slight raising, like a median swelling, of the vertebral region immediately preceding the caudal peduncle.

On the blind side, the aberrant aspect is much more striking. At the point mentioned, *i. e.* 50 millim. in advance of the caudal

peduncle, the colourless lower surface is squarely truncate, and the truncated portion, 45 millim. in diameter, is fringed with a series of rays, 7 in number, connected by a membrane which forms a continuum with the dorsal and anal fins. Just in front of this truncature, the lateral line divides into two branches terminating at the base of the abnormal fin. Behind the truncated part, which

Text-fig. 28.



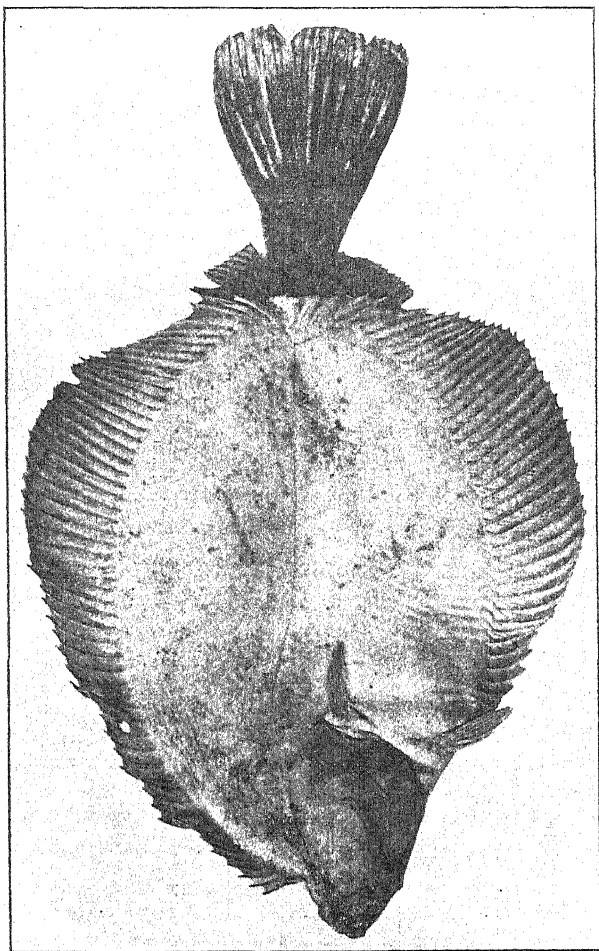
Coloured side of malformed Plaice, caudal end.

is thin and contains bony supports to the fin-rays, and separated from it by a deep groove, the normal region reappears, normal but for the fact that the two sides are scaled and coloured exactly alike, instead of the lower side being colourless and clad with smaller scales.

Mr. Boulenger suggests as an explanation of this wonderful

"freak" that, at an early stage of its existence, the fish lost the posterior part of its caudal region, at the point now indicated by the truncature on the blind side; it at once proceeded to repair the injury by producing a secondary terminal fin, viz., the transverse fin connecting the dorsal with the anal—similar structures

Blind side of malformed Plaiçe.



Text-fig. 29.

being well known in the regenerated tails of some fishes. But at the same time, or soon after, the true tail asserted its rights, and grew again, alongside the secondary fin, and this regeneration would fall under what Prof. Giard has designated as "*Régénérations hypotypiques*" (C. R. Soc. Biol. iv. 1897, p. 315), an



atavistic phenomenon to which Mr. Boulenger was one of the first to draw attention (P. Z. S. 1888, p. 351).

As Prof. Giard has defined it, hypotypical regeneration represents a sort of abridgment of the processes of reintegration, by which the regenerated part corresponds, not to the state of stable equilibrium prevailing in the given form or type, but to a previous state of equilibrium, usually to the maximum of stability immediately preceding that of the present state of evolution. As flat-fishes are undoubtedly derived from symmetrical forms in which both sides are similarly coloured and scaled, the present case, if correctly interpreted, is another to add to the numerous examples of this phenomenon which have been furnished by various groups of the animal and vegetable kingdoms.

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Mr. Walter A. Kidd, M.D., M.R.C.S., F.R.S.E., F.Z.S., gave an account, illustrated by diagrams, of observations he had made regarding the effects of pressure on the direction of hair in Mammals.

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The following papers were read:—

1. The Rudd Exploration of South Africa.—IX. List of Mammals obtained by Mr. Grant on the Gorongosa Mountains, Portuguese S.E. Africa. By OLDFIELD THOMAS, F.R.S., F.Z.S., and R. C. WROUGHTON, F.Z.S.

[Received February 27, 1908.]

In order to make the collection from the Pungwe River district of Portuguese S.E. Africa more complete, Mr. Grant spent some weeks in the Gorongosa Mountains, and there made the present collection, which forms a useful supplement to the Beira series, of which we gave an account in our last paper\*.

The series consists of about 150 specimens, belonging to 31 species and subspecies, of which we have described three as new, while many are rare forms of which the additional material will be of the utmost service as the different groups are worked out.

The following are Mr. Grant's notes on the place he worked at:—

“Tambarara lies on the foothills under the south-western slope of the Gorongosa Mountains; roughly 300 m. (975 feet) above sea-level, in a very typical stretch of country. Higher up collecting was impossible, owing to the height of the grass.

“Both the foothills and mountain-slopes are here clothed with virgin forest, in parts of great beauty.

“Many of the forest trees are of great size and comprise ‘native mahogany,’ ‘teak,’ &c., &c.

\* P. Z. S. 1907, p. 774.

"The thick forest, however, does not extend far either to the south or north-west, its place being taken by more open forest and bush-veldt. The north-east and north of the range are dry and stony.

"The highest point of the range is said to be 1600 m. (5200 ft.).

"The soil is very fertile, and splendid crops of maize, Kaffir corn, rice, &c. are grown by the natives.

"The climate is healthy and the temperature never rises very high, averaging during the trip 79° in the shade; the rainfall is heavy, and this and the thick mists that often envelop the country keep the trees in a continual state of verdure.

"The natives are a tribe known as the Gorongozas and many gave great assistance, my personal 'boys' taking a keen interest in furthering the work.

"Throughout the trip collecting was difficult, owing to the density of the grass and other undergrowth, which made it impossible to form a really complete series."

### 1. *PAPIO CYNOCEPHALUS* Geoff.

♂. 1871. ♀. 1870.

"Native name, 'Nkerua' ('Bongwi' towards the Zambesi).

"Excessively common everywhere and generally in large troops.

"At the time the crops are ripe it is quite impossible to scare them away even if several are shot.

"Apparently not as pugnacious as the southern species, although dogs are often killed by them. The natives say that the 'old men' will sometimes turn on them.

"The flesh is eaten by the women and children, but seldom by the men."

### 2. *CERCOPITHECUS ALBIGULARIS BEIRENSIS* Pocock.

♂. 1902. ♀. 1802, 1803, 1818.

"Native name, 'Nsimbo.'

"Very common in the forest, to which they are confined, and often observed in very large troops.

"At first they were tame and specimens were easily obtainable, but they soon became wild and after a few weeks were seldom seen.

"Living on wild fruits, young shoots of trees, &c., and seldom damaging the natives' crops."

### 3. *CERCOPITHECUS PYGERYTHRUS RUFOVIRIDIS* I. Geoff.

♂. 1819, 1880, 1917, 1936. ♀. 1842.

"Native name, 'Ukoro.'

"Not quite so common as the last species, but still very plentiful and often observed in large troops.

"When the native crops are ripe they visit the lands and do considerable damage."

4. *GALAGO CRASSICAUDATUS* E. Geoff.

♂. 1886, 1889, 1899, 1934. ♀. 1887, 1888, 1890, 1891, 1892, 1897, 1898, 1901.

"Native name, 'Gwea.'

"Very common in the forests, where they appear to consort together in small parties.

"The species has a variety of calls, none of which, however, are similar to that of *Galago garnetti*.

"Apparently principally vegetarian, and feeding largely on the exudation from the bark of certain trees.

"Strictly nocturnal, passing the day in hollow trees."

5. *GALAGO GRANTI* Thos. & Wrought.

♀. 1905, 1906, 1907, 1911, 1912, 1913.

"Native name, 'Konsiti.'

"Common; habits similar to those of its congener at Inhambane and elsewhere."

6. *SCOTOPHILUS NIGRITA* Schreb.

♂. 1919, 1920, 1921, 1922. ♀. 1923, 1924.

We follow the precedent we established in dealing with the Inhambane and Beira collections, and provisionally accept these specimens as *S. nigrita*, merely noting that they all belong to the larger form.

"Native name, 'Nyagelingwelingwe.'"

7. *CROCIDURA* sp.

1903.

"Native name, 'Nyungeyunge.'"

8. *PETRODROMUS TETRADACTYLUS* Pet.

♂. 1824, 1844, 1845, 1857, 1877, 1895, 1914. ♀. 1840, 1841, 1846, 1847, 1893, 1894, 1896.

"Native name, 'Gumbwa.'

"Common in the thickest part of the forest and having regular runs in which they are easily trapped."

9. *GENETTA* sp.

♂. 1839, 1900, 1910, 1935, 1944. ♀. 1885, 1925.

This is very possibly *zambesiana*, though it does not altogether agree with the short description given by Prof. Matschie.

"Native name, 'Mulimba.'

"Common, especially near kraals, where they steal quantities of fowls."

10. *MUNGOS PALUDINOSUS RUBELLUS*, subsp. n.

♀. 1926.

A bright rufous form of the Marsh-Mongoose (*Mungos paludinosus*).

Before describing the new subspecies, however, we have to

show why we use the name *paludinosus* for the Marsh-Mongoose itself.

The name *galera* has hitherto been supposed to date from Erxleben\*, whose primary basis for the name was the "Galera" of Brown's 'Jamaica'†, which is no doubt the Marsh-Mongoose. But unfortunately Schreber's plate‡ of "*Mustela galera* Brown," is one year earlier, and instead of being really based on Brown's Mongoose, is a mere coloured copy of Buffon's figure§ of the "Vansire" of Madagascar, which, as Gray suggested in 1864||, is certainly the animal usually known as *Galidia elegans* I. Geoff. Consequently this latter must bear the name of *Galidia galera* Schreber, and another name be found for the Marsh-Mongoose.

The next names on the list, *Viverra nems* and *Mustela afra* of Kerr¶, seem to be equally inapplicable, when critically examined. The first is based on the "Nems" of Smellie's Buffon, which appears to be some form allied to the common Indian Mongoose, while the second is again primarily based on the Madagascar "Vansire" (*Galidia galera*), and should be considered as a synonym of that animal.

Next among the synonyms usually quoted comes *Ichneumon major* E. Geoffroy\*\*, but this is based on Buffon's "La Grande Mangouste"††, which there is no reason to consider as anything but a large individual of *Mungos ichneumon*.

Then follows the "Vansire" (*Atilax vansire*) of Geoffroy and F. Cuvier‡‡, which is undoubtedly the Marsh-Mongoose, but though the figure and description date from 1826, the technical name was only given to the animal on the appearance of the General Index in 1842.

Before this latter date there was published G. Cuvier's name *Herpestes paludinosus*§§, which antedated Smith's *Mungusta urinatrix*||| by one month, and appears to be the tenable title of the animal under consideration.

The description of the new form is as follows:—

About the size of typical *M. paludinosus*.

Upper surface of body clothed with a close, soft fur, about 15 mm. long, under a pelage of long (50–60 mm. on the back) hairs, somewhat harsher than in *paludinosus*.

General colour above near "tawny ochraceous," obscurely mottled with black; individual hairs, basal  $\frac{1}{2}$  slaty marked with four rings of dirty whitish at intervals, distal  $\frac{1}{2}$  made up of 10 mm. tawny and tip (5 mm.) black; fur slaty. On the flanks and belly

\* Syst. R. A. p. 453, 1777. † P. 485, pl. xlix., 1756.

‡ Säug. iii. pl. 135, 1776 (quoted by Erxleben).

§ Hist. Nat. xiii. p. 167, pl. xxi., 1765.

¶ P. Z. S. 1864, p. 523.

|| Linn. Syst. Nat. pp. 160 & 175, 1792.

\*\* Descr. Egypte, Hist. Nat. ii. p. 139, 1812.

†† Hist. Nat. Supp. iii. p. 173, pl. xxvi., 1776.

‡‡ H. N. Mamm. iii. pl. 198, 1826.

§§ Règne Anim. (2) i. p. 158, April 1829.

||| Zool. Journ. iv. p. 437, May 1829.

tawny, bases of individual hairs buffy; fur as above. Face to the nape greyer than body, finely grizzled black and whitish; upper lip, chin, and throat buffy. Hands and forearm, feet to the ankles, and chest blackish (forearm and chest grizzled, owing to the presence of pale rings on the individual hairs). Tail coloured like the back, except at the extreme tip (50 mm.), where black predominates.

Skull much as in typical *paludinosus*; heel of last lower molar measurably larger than in the Cape form.

Measurements of the type:—

Head and body 462 mm.; tail 375; hind foot 105; ear 36.

Skull: greatest length 102 mm.; basilar length 85; zygomatic breadth 50; length of m<sup>1</sup> 7.

*Hab.* Tambarara, Gorongoza Dist., Portuguese East Africa.

*Type.* Young female. B.M. No. 8.1.1.53. Original number 1926. Collected 8th May, 1907.

The rich rufous colour of this Mongoose will readily distinguish it from any of the described forms of *M. paludinosus*.

# 11. RHYNCHOGALE MELLERI Gray.

♂. 1861.

# 12. BDEOGALE CRASSICAUDA Pet.

♀. 1947.

An examination of this specimen, which we provisionally identify as *Bd. crassicauda*, makes it clear that two specimens received from Mr. J. T. Last from Zanzibar Island represent a new species, and we take this opportunity to publish a description of it under the name of

## BDEOGALE TENUIS, sp. n.

A small, short-tailed form.

Covered above with a dense, soft underfur (15 mm.), mixed with longer hairs (25–30 mm.), forming an outer coat, scarcely concealing the underfur; longer hairs entirely absent on the belly. Tail cylindrical, its individual hairs about 25 mm. in length. General colour buffy clay, washed with black—the former being the colour of the underfur, the latter that of the longer hairs. On the shoulders and sides of neck, however, these longer hairs are white-tipped and thus produce a grizzled appearance. Face, hands, and feet tawny. Tail black.

Skull small. Teeth proportionally large.

Measurements (those of the body from a dried skin):—

Head and body (c.) 410 mm.; tail 180; hind foot 70; ear 20.

Skull: greatest length 77 mm.; basal length 69.5; greatest breadth 42; upper cheek-tooth series 22; palatal length 41; breadth across m<sup>1</sup> 25.

*Hab.* Zanzibar Island.

*Type.* Old individual (sex unknown). B.M. No. 6.6.5.18. Presented by the collector, Mr. J. T. Last. Two specimens.

13. *VIVERRA CIVETTA* Schreb.

♀. 1828.

"Native name, 'Mfungo.'"

14. *CROSSARCHUS FASCIATUS* Desm.

♂. 1941. ♀. 1810 (juv.), 1942.

"Native name, 'Ndembo.'"

"Quite common, but not easy to secure."

"Always observed in troops, often of considerable size. The troops seem to comprise a great proportion of immature individuals; in one instance I killed five from a troop with one shot, four of which were young."

"Living almost exclusively on insects, for which they diligently search everywhere, uttering continually the peculiar chattering which generally betrays their whereabouts."

"Exclusively diurnal."

15. *FUNISCIURUS MUTABILIS* Pet.

♂. 1798, 1868, 1904, 1909. ♀. 1829, 1869, 1916.

"Native name, 'Sindi.'"

"Very common in the forest; always in pairs."

16. *FUNISCIURUS CEPAPI* A. Sm.

♂. 1915, 1918.

"Native name, 'Konkwa.'"

"Fairly common, more so in the open 'bush veldt' than in the real forest."

"Feeding on various seeds and fruits—especially, when in season, the fruit of the Mafura."

"Diurnal only."

17. *TATERA INCLUSA*, sp. n.

♂. 1838. ♀. 1879.

A large *Tatera*, with tail longer than head and body.Size about as in *T. draco*.

Fur soft but short, about 10 mm. in length on the back.

Ground-colour above "ochraceous buff," more or less modified by black, below white. Individual hairs of the upper surface dark slate-colour, tipped with ochraceous on the sides, subterminally ringed with ochraceous and tipped with black in the dorsal region; of the belly white from their bases. Hands and feet white. No white tip to tail.

Skull narrower than in *T. draco*, with longer nasals and upper molar series; the upper incisors less deeply grooved, the groove less central.

The following are measurements (those of the body taken by the collector):—

Head and body 163 mm.; tail 184; hind foot 39; ear 27.

Skull: greatest length 44 mm.; basilar length 35; zygomatic breadth 23; length of upper molar series 7; bullæ 11.

*Hab.* Tambarara, Gorongosa Dist., P. E. A. Alt. 1300 ft.

*Type.* Adult male. B.M. No. 8.1.1.79. Collector's number 1838. Taken 20th March, 1907.

The second specimen, an adult female, is rather smaller, but the hind foot, ear, upper molar row, and bullæ are exactly as in the type. (The collector records "Ear 22," but this is an evident mistake.)

The appearance of this very distinct form in this region is interesting. The Gerbils found at Mazoe on the high plateau to the west and at Beira at sea-level to the south are races of *T. lobengulæ*, while the forms north of the Zambesi are short-tailed ones. This is apparently a species confined to the mountainous Gorongosa country and is perhaps allied to *T. draco*, also an animal with a very restricted habitat on the Drakensberg at Wakkerstroom.

In Wroughton's key to the species of the genus *Tatera* (A. M. N. H. xvii. p. 475, 1906) this species would come next to *T. afra*, from which it may be distinguished by its longer hind foot and ears (viz. 39 and 27 to 34 and 24 respectively in *T. afra*), its longer, narrower skull, and larger teeth.

"Native name, 'Mpynya.'

"Apparently not common, the soil not being suited to its habits."

#### 18. *ARVICANTHIS DORSALIS* Sm.

♂. 1799, 1808, 1816, 1817. ♀. 1800, 1804, 1806, 1807, 1811, 1812.

"Native name, 'Mhoni.'

"Very common everywhere, especially in the native 'lands.'

"Diurnal only."

#### 19. *SACCOSTOMUS CAMPESTRIS* Pet.

♂. 1822, 1832, 1835, 1863, 1883.

The series of specimens of the genus *Saccostomus*, like that from Beira, seems to contain two forms separable by size, and for these we adopt as before the names *S. campestris* and *S. mashonæ*.

"Native names, 'Tuda' and 'Suka.'

"Common in the natives' 'lands' and along the banks of the streams.

"Nocturnal and strictly vegetarian."

#### 20. *SACCOSTOMUS MASHONÆ* de Wint.

♂. 1834, 1878, 1882. ♀. 1836.

#### 21. *MUS RATTUS* Linn.

♂. 1826. ♀. 1853 *a.*

22. *MUS CHRYSOPHILUS* de Wint.

♂. 1821. ♀. 1830.

"Native name, 'Mpynya.'

"Common; habits as elsewhere in S. Africa."

23. *MUS COUCHA* A. Sm.

♂. 1809, 1813, 1814, 1820, 1823, 1825, 1837, 1853. ♀. 1805, 1815, 1831, 1856, 1884.

"Native name, 'Nhingó.'

"Common; habits as elsewhere in S. Africa."

24. *CRICETOMYS GAMBIANUS CUNCTATOR*, subsp. n.

♂. 1801, 1862, 1865, 1867, 1872. ♀. 1849, 1864, 1866, 1873.

Size and general characters as in the races *viator* and *adventor* of *C. gambianus*, between which it is geographically intermediate. On the upper surface approaching nearest, in coloration, to *viator*, but the ochraceous on the flanks and shoulders brighter than in that form, the white on the face limited to the upper lip at the angle of the mouth, not spreading over the cheeks as in *adventor*; white tip less than  $\frac{1}{2}$  the length of the tail, as in *viator*, it is more than  $\frac{1}{2}$  in *adventor*. On the other hand, the colour of the back gradually passes into that of the belly as in *adventor*, very different to the comparatively sharp line of demarcation found in *viator*. Belly-hairs tinged with yellowish, with pale slaty bases, while in both the other forms they are pure white to their bases. A patch of pure white on the chest.

Skull and teeth as in *adventor*.

Dimensions of the type:—

Head and body 370 mm.; tail 454; hind foot 71; ear 43.

Skull: greatest length 76 mm.; basilar length 64; zygomatic breadth 36; nasals  $31 \times 10$ ; interorbital breadth 11.5; palatal foramina 9; length of upper molar series 12.*Type.* Adult male. B.M. No. 8.1.1.130. Original number 1862. Collected 6th April, 1907.*Hab.* Tambarara, Gorongosa Dist., Portuguese East Africa.

Though it appears that *cunctator* has certain characters in common with *viator* and others with *adventor*, and that there is a considerable amount of individual variation in coloration, still the yellowish tinge and slaty bases of the belly-hairs and the constantly present pure white breast-patch serve to distinguish this race from either of its neighbours.

"Native name, 'Kurubini.'

"Very common, especially in the forest, where it often lives singly.

"Its holes are often placed at the foot of some forest tree and also amongst thick vegetation.

"Nocturnal only and considered a great delicacy by the natives, by whom great numbers are taken."



25. *ACOMYS SELOUSI* de Wint.

1848 (no skull).

'Native name, 'Chedare.'

"Apparently rare at Tambarara, as only one specimen was secured or seen."

26. *PELOMYS FALLAX* Pet.

♂. 1827, 1843. ♀. 1855.

'Native name, 'Bungo.'

"In habits similar to *Otomys irroratus*, and like that species found in the thick grass and vegetation bordering the streams.

"Diurnal and a vegetarian."

27. *GEORYCHUS BEIRÆ* Thos. & Wrought.

♂. 1860 (juv.).

'Native name, 'Mfusi.'

"Apparently common, but none could be trapped and very few runs were observed, probably owing to the thick grass and vegetation."

28. *THRYONOMYS SWINDERIANUS* Temm.

♂. 1850, 1851, 1875, 1876.

'Native name, 'Nsensi.'

"Common along the banks of the rivers and streams.

"They do much damage to the native rice-patches, in consequence of which the natives have to stockade their fields and continually trap them."

29. *PROCAVIA BRUCEI* Gray.

♂. 1929, 1930, 1931. ♀. 1928, 1932, 1933.

"These specimens perhaps represent *Hyrax mossambicus* of Peters.

'Native name, 'Imbile.'

"Very common in the kranzes and masses of loose boulders on the mountain-sides.

"Habits as the ordinary Dassie.

"According to the natives, this is the only Dassie found in the Gorongoza Range.

"Diurnal and feeding morning and late afternoon."

30. *CEPHALOPHUS NATALENSIS* A. Sm.

♂. 1852, 1874.

'Native name, 'Kutwa.'

"Fairly common, seems more partial to the more heavily timbered parts of the forest.

"Is extremely wary and trapping has usually to be resorted to in order to secure specimens."

31. *CEPHALOPHUS MONTICOLA* Thunb.

♂. 1858, 1859. ♀. 1881.

"Native name, 'Nyakoro.'

"Common in the forest, and often observed in pairs, but never more together.

"Generally can only be shot in the early morning and late afternoon, when they are feeding.

"They are extremely wary, the alarm-cry is a sharp whistle, almost a shriek."

32. *CERVICAPRA ARUNDINUM* Bodd.

1937.

"Native name, 'Sengo.'"

33. *TRAGELAPHUS SCRIPTUS* Pall.

♂. 1949 (juv.). ♀. 1908, 1833. Tambarara.

"Native name, 'Nsome.'"

2. Notes upon some Species and Geographical Races of Serows (*Capricornis*) and Gorals (*Næmorhedus*), based upon Specimens exhibited in the Society's Gardens. By R. I. POCKOCK, F.L.S., Superintendent of the Gardens\*.

[Received March 2, 1908.]

(Text-figures 30-38.)

## I. Introduction.

Serows and Gorals, which, as I have recently shown †, must be known scientifically as *Capricornis* and *Næmorhedus*, and not as *Næmorhedus* and *Urotragus* or *Kemas* respectively, are very rare animals in captivity. Within the last four years, however, the Zoological Society has had the good fortune to exhibit no fewer than two well-marked species or subspecies of each of these genera‡. The necessity for determining these animals correctly involved the looking up of a good deal of the literature, especially the older literature, of the subject; and this brought to light a wholly unexpected amount of confusion in nomenclature, both generic and specific, and not a few mistakes and misconceptions as to specific characters in recent catalogues and treatises on these ruminants.

The specimens of the two kinds of Serow (*Capricornis*) exhibited

\* [The complete account of the new species and subspecies described in this communication appears here; but, as the names and preliminary diagnoses were published in the 'Abstract,' the species and subspecies are distinguished here by the names being underlined.—EDITOR.]

† Ann. Mag. Nat. Hist. (8) i. pp. 183-188, 1908.

‡ Not including a young example of a third species of Goral from Nepal which was presented by the Prince of Wales, but lived only a few days after arrival.

in the Gardens came from widely separated localities—one from Kalimpong, near Darjiling, and the other from Selangor, in the Malay Peninsula. Identification of the former necessarily entailed examination of all the available material from the Himalayas, which resulted in the discovery of one or two undescribed forms. The Kalimpong specimen itself proves to be a representative of an unnamed local race, distinguishable from the typical Nepalese race described by Hodgson, the name of which has hitherto been applied to all the Serows of the Himalayas. For the opportunity to describe a second Himalayan race I am indebted to Major G. S. Rodon, F.Z.S., who very kindly sent to me the perfect skin and skull of a specimen shot by himself at Chamba. A third hitherto unnamed local race from these mountains is exemplified in the British Museum by a mounted head from Kashmir belonging to the Hume collection. Finally, the determination of the example from Selangor showed that it, too, was nameless, since it presented characters not previously recorded in any race of Serows. These characters I consider worthy of nominal recognition, when taken into consideration with the geographical distribution of the animal.

With regard to the two Gorals (*Nemorhedus*) the Society has lately exhibited, these belonged to two very distinct species. One of the specimens, which is still living, was presented to the Society by Major G. S. Rodon, F.Z.S., who brought it from Chamba; and I am indebted to Major Rodon for kindly sending to me for examination a series of skins of specimens shot in the same locality by His Highness the Maharajah of Chamba. The second specimen came from the mountains of Korea, whence Gorals have not been previously recorded, and was presented to the Society by Mr. C. F. S. Bilborough, F.R.G.S.

Although neither of these Gorals represents, in my opinion, an undescribed form, their determination revealed some hitherto unrecorded facts touching the nomenclature, variability, and distribution of some of the Gorals of North India and China.

## II. *On the Serows (Capricornis) of the Himalayas, the Malay Peninsula, and Sumatra.*

### GENUS CAPRICORNIS Ogilby.

*Nemorhedus* Hamilton Smith, Griffith's Animal Kingdom, v. p. 352, 1827 (in part).

*Capricornis* Ogilby, P. Z. S. 1836, p. 138; Gray, List Mamm. B.M. pp. xxvi & 166, 1843; and subsequent works.

*Nemorhædus* Blanford, Fauna Brit. Ind., Mammalia, p. 512, 1891; Lydekker, Great and Small Game of India, p. 128, 1900, and id. *op. cit.* nov. ed. p. 139, 1907.

*Capricornis* Heude, Hist. Nat. Chinois, ii. pp. 222 & 234, 1894.

*Nemotragus* + *Lithotragus* + *Austritragus*, id. *op. cit.* iv. pp. 13-14, 1898.

*Capricornis* Pocock, Ann. Mag. Nat. Hist. (8) i. pp. 183-188, 1908.

The principal external differences between the various kinds of Serows that have been described are differences of colour of a very simple kind. They consist, for the most part, in the substitution of the three tints, black, red, and white, on definite areas of the body and limbs—that is to say, a part which in one form is black may be red in a second and white or grey in a third. For example, the legs below the knees and hocks are white in *C. sumatraensis rodoni*, red in *C. s. milne-edwardsi*, and black in *C. s. swettenhami*. The mane is hoary white in *C. s. sumatraensis* and *C. s. argyrochates*, red or mostly red in *C. s. rubidus*, black in *C. s. jamrachi*, a mixture of black and white in *C. s. robinsoni*, and of black, white, and red in *C. s. swettenhami*. Similarly the underside is almost wholly white in *C. s. rodoni*, and reddish black in *C. s. jamrachi*. Finally, the prevailing colour of the body in *C. s. jamrachi* is black, while in *C. s. rubidus* it is red. These three colours, black, red, and white, or a mixture of any two of them, or of the three combined, are the commonest variations to occur in domestic mammals. Horses, for example, may be black, red (bay), or white, or black and white (piebald), or bay and white (skewbald), when the colours are arranged in patches, or roan when the coat consists of an intimate mixture of black and white or bay and white hairs. The passage from one of these three tints to the others is a common and, be the cause what it may, an apparently simple phenomenon. It is for this reason that I regard the differences between the various kinds of Serows as of subspecific and not of specific importance, in spite of the fact that there is in most cases no actual proof of the existence of intermediates between the different forms that have been named\*. For the present, at all events, therefore I agree with Mr. Lydekker in considering all the many described forms as belonging to a single species, which must take the name of the race that was first made known, namely the one from Sumatra which Bechstein described as *Antelope sumatraensis*†.

\* It is the custom with some systematic zoologists to consider an insular form *ipso facto* as a species whatever grade of difference it presents from other insular forms or from the form from the adjacent mainland, on the grounds that the discontinuity in geographical distribution involves the non-existence of actual intermediate types. Were I to follow this course with respect to the Serows, I should be compelled to separate the Sumatran animal specifically from those from the mainland of Malacca, while uniting the latter specifically with those from Burma, China, and the Himalayas. Such a course, however, would, in my opinion, be a gross contravention of common sense, because it would give a higher systematic value to the comparatively trivial differences between the Sumatran and Southern Malayan animals than to the comparatively important differences between the Southern Malayan and Himalayan animals. In this and analogous cases it is surely a mistake to make geographical isolation the criterion of the value of a character. The character should be judged on its own merits and its importance determined by a study of the extent of the variation to which the particular species or allied species are liable.

† Pocock, Ann. Mag. Nat. Hist. (8) i. p. 187, 1908. For the discovery of this early name for the species I am indebted to Mr. C. D. Sherborn's invaluable 'Index Animalium.'

The genus *Capricornis* ranges through the Himalayas from Kashmir eastwards into Southern China and thence southwards through Burma and the Malay Peninsula into Sumatra.

CAPRICORNIS SUMATRAENSIS Bechst.

*Antilope sumatraensis* Bechstein, Uebersicht vierfüss. Thiere, i. p. 98, 1799 (based on the Cambing Outan, Marsden's Sumatra, ed. i, p. 93).

*Antilope sumatrensis* Shaw, Gen. Zool. ii. pt. 2, p. 354, 1801.

*Nemorhedus sumatrensis* H. Smith, Griffith's An. King. iv. p. 277, 1827; Jardine, Nat. Libr., Mamm. iv. p. 97, pl. ii., 1836.

*Antilope interscapularis* Lichtenstein, Berlin Mag. vi. p. 165, 1814.

Nec *Nemorhedus sumatrensis* Blanford, Fauna Brit. India, Mammalia, p. 514, 1891; Lydekker, Great and Small Game of India, p. 128, 1900; id. *op. cit.* nov. ed. p. 139, 1907; id. in Rowland Ward, Records of Big Game, p. 345, 1907.

The typical race of this species differs from all the known Himalayan forms in having the mane on the neck and withers hoary grey and contrasting forcibly with the dark coat of the rest of the body, and also in having no sharp line of demarcation in colour between the upper and lower portions of the legs, which are blackish below the knees and hocks, merely fading to dark brown upon the fetlocks. The conspicuousness of the mane obviously suggested the name *interscapularis* given to this animal by Lichtenstein.

It is to be noted that Dr. Blanford must have omitted to look up the original literature of this species, since he assigned the name *sumatrensis* to Serows from Moupin, Burma, the Malay Peninsula, and other localities which are quite different from the Sumatran form; and I have reason to think that, misled by him, Mr. Lydekker, in the works quoted above, described as typical *C. sumatrensis* the Darjiling Serow to which I have given below the subspecific name *janurachi*.

It may be added that for many years there has been in the British Museum a subadult specimen of a Sumatran Serow agreeing in all essential respects with the examples figured and described by earlier authors as *Antilope* or *Nemorhedus sumatrensis* (*sumatrensis*). It was originally presented to the Zoological Society by Sir Stamford Raffles. Inspection of this specimen by later authors would have saved all the misconception as to the characters of this race which have been so frequently repeated in recent literature on the subject.

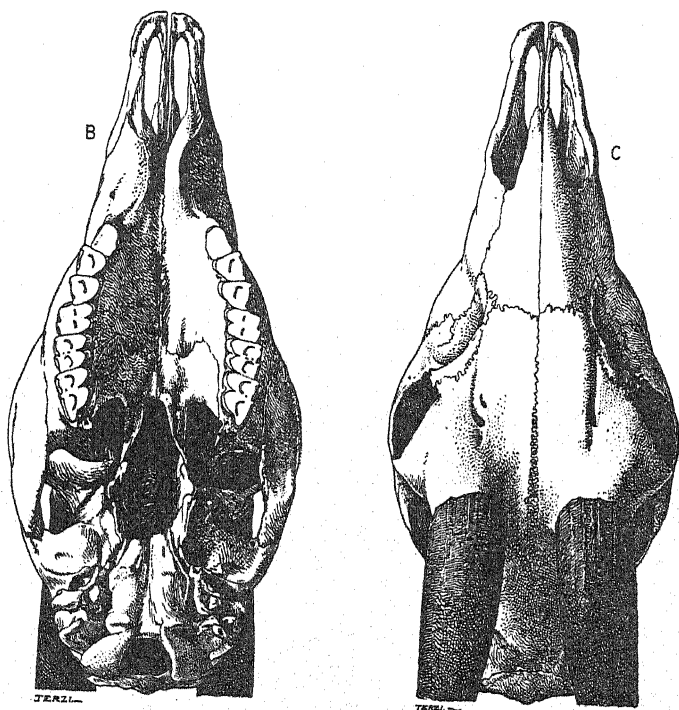
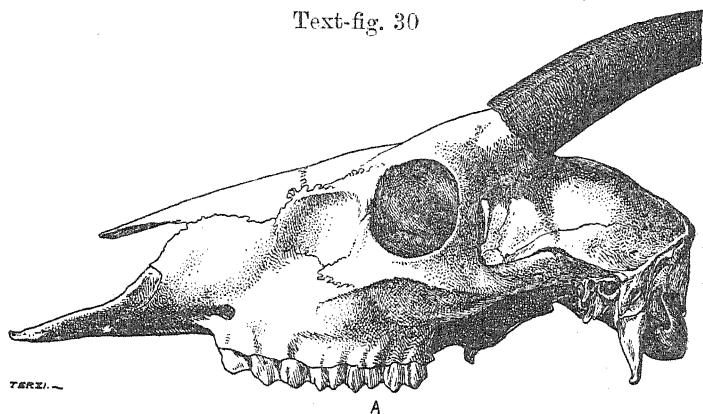
Subsp. *thar* Hodgson.

The Bubaline Antelope, Hodgson, Gleanings in Science, iii. p. 122, April 1831 (no scientific name).

*Antilope thar* Hodgson, Gleanings, iii. p. 324, Oct. 1831; id. P.Z.S. 1833, p. 105.

*Antilope* (*Nemorhedus*) *thar* Hodgson, P.Z.S. 1834, p. 86.

Text-fig. 30



Skull of *Capricornis sumatraensis thar* Hodgs., from Nepal.  
(B.M. Reg. 55.12.26.143.)  $\times \frac{1}{2}$ .

A, from the side; B, from below; C, from above.

*Capricornis thar* Ogilby, P. Z. S. 1836, p. 138; Pocock, Ann. Mag. Nat. Hist. (8) i. p. 187, 1908.

*Antilope bubalina* Hodgson, P. Z. S. 1832, p. 12.

*Nemorhædus* or *Capricornis bubalinus* (in part) of most recent authors.

Hitherto only one kind of Serow has been distinguished in the Himalayan area. Of late years this has been invariably but erroneously cited as *Nemorhædus bubalinus*, after the example set by Blanford in his volume on the Mammalia of British India. Blanford, however, quite candidly pointed out that the oldest and therefore the correct specific (or subspecific) name for this animal was *thar*. Unfortunately this disregard for the rules of priority has been followed by authors who succeeded him. The early literature dealing with this Serow has been here repeated to emphasise the fact that *thar* is its proper name.

The only material of this race that I have been able to examine are four stuffed skins in the British Museum. Two of these belonged to Hodgson's collection and came from Nepal. They are the co-types or syntypes of the race; a third also came from Nepal; and a fourth, which appears to be inseparable from the others, was from Sikhim and belonged to Dr. Blanford, who mentioned it in his volume on Indian Mammals.

The characters of this race are briefly but, for my present purpose, sufficiently enumerated in the following pages.

Subsp. HUMEI Pocock.

Abstr. P. Z. S. No. 55, p. 12, March 17, 1908.

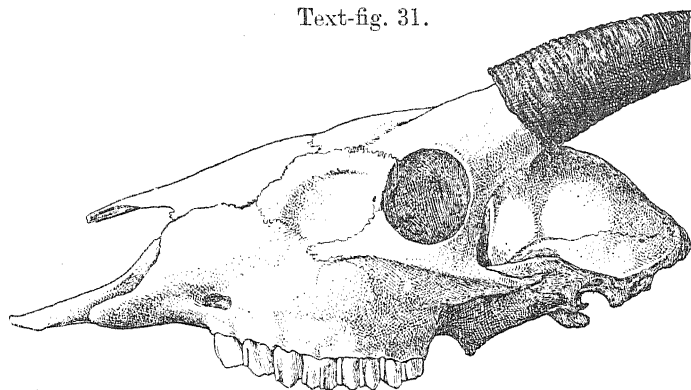
Distinguishable from the other geographical races of Serows occurring more to the east in the Himalayas by having the whole head a uniform pale chocolate-brown without any intermixture of black. Some black hairs amongst the brown on the anterior part of the neck. Anterior part of the lower jaw on each side white; no white throat-patch.

*Loc.* Kashmir.

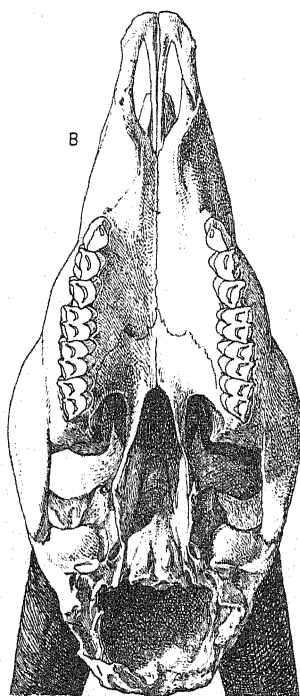
*Type.* The mounted head of an adult example in the British Museum formerly belonging to the collection of Mr. A. O. Hume.

Further evidence of the distinctness of the Kashmir form from the typical *C. s. thar* is supplied by the skull of a specimen, formerly belonging to Mr. R. Lydekker, from Pir Punjal in Kashmir. This skull differs in a number of particulars from two skulls of *C. s. thar* obtained by Hodgson in Nepal—particulars which combine to make the general "facies" of the skulls from the two localities very different. In the Kashmir skull the cheek-teeth are smaller, the palate wider, and the frontals and nasals more convex. The last-mentioned is the first distinctive feature that catches the eye upon a superficial glance at the skulls. There is, of course, no actual proof that the skull of the type of this race resembles the skull from Pir Punjal nor that the colouring of the Pir Punjal specimen resembled that of the type.

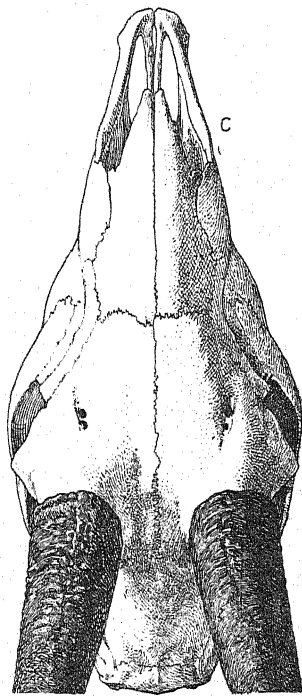
Text-fig. 31.



A



B



C

Skull of *Capricornis sumatraensis humei* Poc., from Pir Punjal in Kashmir.  
(B.M. Reg. 88.3.20.16.)  $\times \frac{1}{2}$ .

A, from the side; B, from below; C, from above.

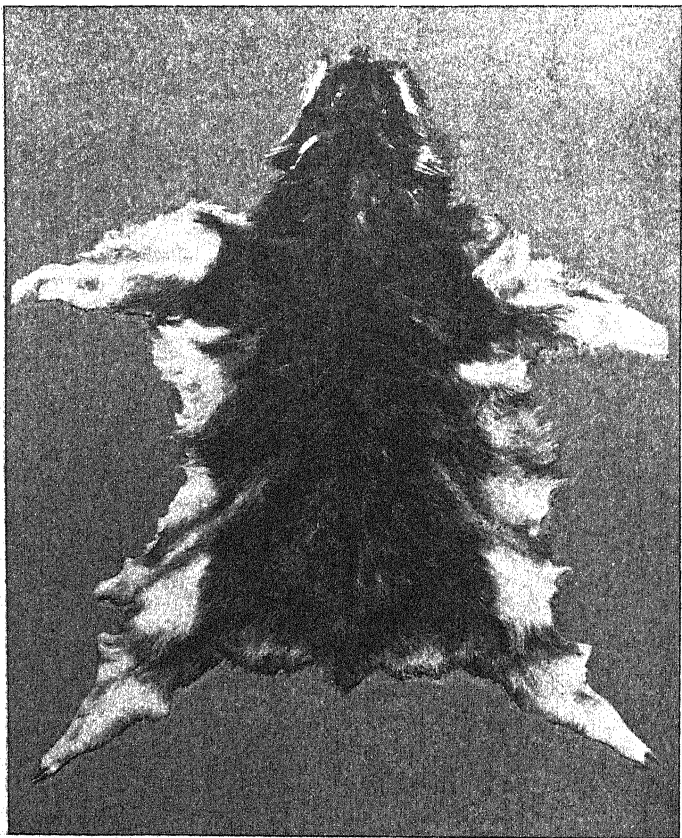


Subsp. RODONI Pocock

Abstr. P. Z. S. No. 55, p. 12, March 17, 1908.

General colour of upper parts of head and body not jet-black but brownish black, due to the presence of a decided rufous tinge in the black terminal portion of the hairs. This rufous tinge is

Text-fig. 32.



Flat skin of *Capricornis sumatraensis rodoni* Poc., from Chamba. Type.

observable even in the hairs forming the mane on the middle line of the neck and along the spine. The forehead and the summit of the muzzle are nearly black, but the rufous colour persists as a narrow ring on most if not all the hairs. On the sides of the

head below the eye the rufous speckling is much more in evidence, and it is particularly well marked on the corners of the upper lip and at the base of the ear in front and up the back of that organ. Upper lip, lower lip, and chin white; the white from the chin extending backwards along the jaw and over the interramal area to the upper part of the throat, where it expands into a conspicuous patch. In the centre of the interramal area, behind the chin, there is a distinct elongated patch of dusky-brown hair, and behind this patch the hairs of the interramal area and of the throat-patch are not wholly white but apically infusate. On the shoulders and on the sides of the body the rufous area in the hairs gradually increases in extent, so that the general colour above the white of the belly is markedly browner than that of the back. The outer side of the fore leg is rufous brown, intermixed with white in front, down to a point two inches above the knee, and the outer side of the hind leg down from the root of the tail nearly to the hock is also rufous brown, becoming mixed with white inferiorly. The chest, including the whorls of hair, the belly, the insides of the thighs and of the upper part of the fore legs, and the whole of the legs from above the knees and hocks are milk-white, and sharply defined by their colour from the adjacent rufous-brown areas. Only on the chest is the white clouded with a faint brown tinge. The tail, which is triangular and 2 inches long, is brownish black above, like the back.

The coat is long and shaggy, with a long and copious mane on the neck. The hairs on the sides of the body measure about 3 inches, and on the dorsal line of the neck about 8 inches in length. The underfur is plentiful.

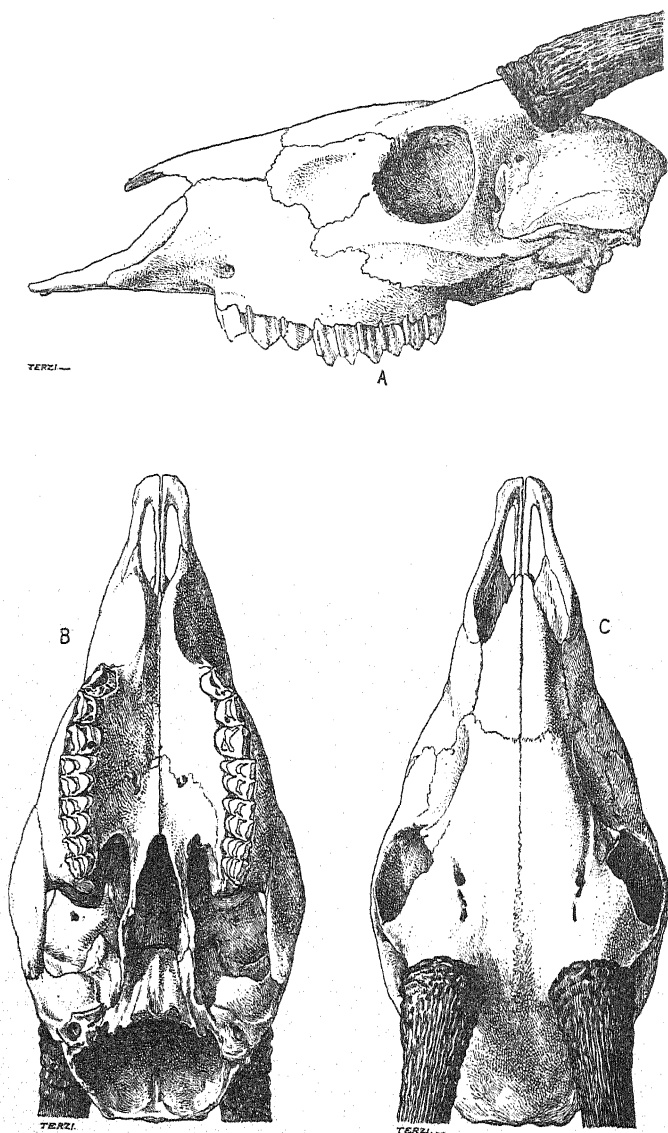
The horns are 8 inches long and  $4\frac{3}{4}$  inches in basal circumference.

Total length of skin from tip of nose to root of tail 52 inches, distance from middle line of shoulder to hoof 34. Tail (skin)  $1\frac{1}{2}$  inches.

#### *Loc. Chamba.*

This Serow differs from examples received from Hodgson from Nepal, and referable to typical *C. s. thar*, both in coloration and the structure of the skull. In the matter of coloration the difference lies principally in the clean whiteness of the whole of the under side, and its sharp definition from the rufous-brown or rufous hue of the sides of the body, and also in the backward extension of the white of the interramal area on to the throat, where it forms a conspicuous white patch. In *C. s. thar* the patch on the throat is absent or represented by a few white hairs, and these are not continuous with the white running along the anterior portion of the lower jaw behind the chin. The under side is not clean white, but dusky brownish grey, the hairs being whitish at the base and sooty grey distally, and the colour of the sides of the body gradually blends with that of the belly and chest. *C. s. thar* is also apparently a shorter and thinner coated form, and the underfur if present at all is scanty. Blanford, indeed (*op. cit.* p. 513), says "no underfur."

## Text-fig. 33.



Skull of *Capricornis sumatraensis rodoni* Poc., from Chamba, belonging to the skin shown in text-fig. 32.  $\times \frac{1}{3}$ .

A, from the side; B, from below; C, from above.

The skull also presents some differences from the skull of a specimen sent by Hodgson from Nepal (text-fig. 30). In the latter, which measures 241 mm. in length from the occipital suture to the premaxillae, the series of upper cheek-teeth measures 87 mm., the last molar being 20 mm. long and 16 wide; the width of the palate between the last molars is 52 and between the first premolars 38. Whereas in the skull of the specimen from Chamba, which measures, as above, 223 mm., the upper cheek-teeth are 93, the last molar  $20 \times 12$ , and the two palatal breadths are 57 and 38. Thus in the specimen from Chamba the tooth-series is longer, the last molar much narrower as compared with its length, and the palate posteriorly broader. The skull is also higher and has the facial pit less deep. Be it noted, however, that it belonged to a younger animal.

The type of *C. s. rodoni* is the above described specimen, which is now in the British Museum.

Subsp. JAMRACHI Pocock.

Abstr. P. Z. S. No. 55, p. 12, March 17, 1908.

General colour of head and body coal-black, the hairs being white at the base and black distally, without any rufous-brown tinge in the black terminal portion. On the upper lip behind the white anterior portion there is a patch of brown, and hairs of a similar brownish-yellow colour surround the base of the ear and extend up the back of that organ. The white patch on the chin extends back on each side of the jaw halfway towards its angle, but there is scarcely any white hair on the throat. The chest also is blackish, and the hairs forming the whorls on the front of the chest near the base of the legs are black, with red basal portion. The belly is a dirty grey-brown. The shoulders are black, but on the fore leg between the elbow and knee, the hairs are a mixture of black and rufous brown, both on the outside and the inside of the limb. The knee itself is white like the fetlocks and pasterns, but the area between the fetlock and the knee (the cannon-bone) is strongly tinged with fawn or rusty yellow. Along a line running from the tail to the stifle, the black of the hind-quarters passes into the rusty-brown colour which pervades the outside and inside of the hind legs. Inferiorly this rusty brown pales to yellowish brown, the fetlocks being white. Except on the fetlocks, knees, inside of ears, upper lip, and chin, there is no white on the animal.

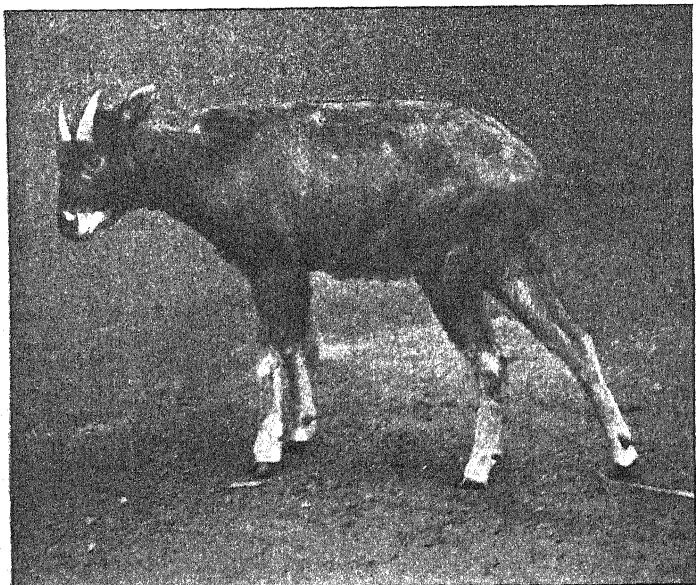
The coat is short at all seasons of the year, and not shaggy, and there is practically no underfur.

*Loc.* Kalimpong, near Darjiling.

A young female specimen of this Serow was purchased by the Society from Mr. W. Jamrach in August 1906. It was then, I should judge, about six months old, and it is important to record that up to the present time (that is to say, during the sixteen months that the animal has been under observation) she has not

changed at all in the matter of colour. She stands about 3 feet high at the withers, but from the size of her horns which measure 6 inches long, with a basal circumference of  $4\frac{1}{2}$  inches, I judge her to be not yet fully adult.

Text-fig. 34.



*Capricornis sumatraensis jamrachi* Poc.

Photograph of specimen from Kalimpong, now living in the Society's Gardens.

In the Mammal Gallery of the Natural History Museum there is a mounted male specimen of this same race of Serow, which was presented by the Duke of Bedford, and is labelled *Nemorhaedus sumatrensis*. According to Blanford's 'Mammals of British India,' this determination is correct; but the animal is obviously quite different from the typical *Capricornis sumatraensis* of Bechstein, which has a grey mat-like mane on the withers and much darker lower legs. From information kindly supplied to me by the Duke of Bedford and Mr. Jamrach, I have been able to ascertain that this animal also came from Kalimpong. Except that there is a noticeable quantity of rusty yellow in the hairs of the forehead, this specimen does not appear to differ in any important particular from the female now living in the Gardens. As in the latter, the horns are rather small, measuring 156 mm. ( $=6\frac{1}{4}$  inches) long, with a basal circumference of

100 mm. (=4 inches). Conceivably the smallness of the horns is a racial character; but I am more inclined to attribute it to immaturity.

The type of *C. s. jamrachi* is the mounted specimen above referred to in the Mammal Gallery of the British Museum (Reg. No. 2.10.12.1).

Of all the extra-Himalayan Serows recorded up to the present time, this subspecies is most nearly allied to *C. s. milne-edwardsii* David \*, from Eastern Tibet. The colour of the body in the latter, however, is not so black as in *C. s. jamrachi*, and the tint of the legs is much more ferruginous. The darkening of the legs is carried still further in *C. s. argyrochaetes* Heude †, from Sze-chuen and Tché-kiang, for the anterior side of the cannon-bone is blackish. The mane, moreover, is grey. In the coloration of the legs *C. s. argyrochaetes* lies midway between *C. s. jamrachi* and the typical *C. s. sumatraensis*, while in the greyiness of the mane it resembles the latter race. Of *C. s. argyrochaetes* the British Museum possesses two specimens, one a flat skin from Sze-chuen, obtained from Berezowski in 1896, the other a mounted specimen said to have come from Tibet, which Mr. Lydekker has recently described and figured (P. Z. S. 1905, p. 329, pl. viii.).

Subsp. ROBINSONI Pocock.

Abstr. P. Z. S. No. 55, p. 12, March 17, 1908.

Prevailing colour black, the hairs white at the root, usually brownish mesially and jet-black in their distal two-thirds. Head black, with a narrow grey rim to the upper lip and corner of the mouth, this grey continuous with a large patch of the same colour tinged in places with brown, which extends backwards to a point on a level with the orifice of the facial gland; chin black. Mane formed of a nearly equal mixture of white and black hairs, without any red; its anterior end, forming the occipital tuft, black with small white tips. The mane does not form a white mat-like patch on the withers. It is continued down the spine as a black crest. On the throat there is a small patch formed by the rufous or white tips to the hairs. On the tail and the outer side of the thighs there is a noticeable quantity of reddish-brown hair, and hairs of a similar hue surround the anus and extend along the edge of the under side of the tail, the upper side of which is black. Lower surface a dirty dark brown; inner side of thighs at base scantily clothed with dirty white hair. Fore and hind legs black, with dark chocolate-brown knees, hocks, and fetlocks.

Measurements in English inches of freshly stripped skin:—

Total length from nose-tip to tail-tip 60, tail 7 (with hair 10). Height at withers 36, hock to heel  $13\frac{1}{2}$ , knee to heel  $10\frac{1}{2}$ , distance

\* Nouv. Arch. Mus. v. Bull. p. 10, 1869. Also A. Milne-Edwards, Rech. Mamm. p. 365, pls. lxxii. & lxxiii., 1874.

† Hist. Nat. Chinois, ii. p. 4, 1888, and p. 228, 1894.

from anterior edge of eye to posterior edge of nostril  $7\frac{1}{2}$ ; ear (along back) 8, inside space  $6\frac{1}{2}$ , width 3.

*Loc.* Selangor, in the Malay Peninsula.

The type of this species is a male specimen kindly presented to the Zoological Society by the Government of Selangor.

The skin and skull are now in the British Museum (Reg. No. 6.11.14.1).

Text-fig. 35.



*Capricornis sumatraensis roosei* Poc.

Photograph of specimen, from Selangor, that formerly lived in the Society's Gardens.

This Serow closely resembles the typical Sumatran form of the species, *C. s. sumatraensis*, in the black colouring of the lower half of the legs. So far, indeed, as I can judge, it differs from the latter only in having the mane less grey and less copious and thick on the withers. As might be expected from its distribution, it is almost intermediate between the Sumatran race and the one from the Larut Hills in Perak, *C. s. swettenhami* Butler\*. Of the latter I have only seen one flat skin, ticketed Biserat

\* P. Z. S. 1900, p. 675. Mr. Butler, misled by Blanford, separated this form from *C. s. sumatraensis* because of the blackness of the lower legs, which Blanford erroneously described as rufous in *C. s. sumatraensis*. See also S. S. Flower, P. Z. S. 1900, p. 371.

in the Malay Peninsula. This is in the British Museum (Reg. No. 3.2.6.77). Butler records the animal from the Larut Hills in Perak. In the Biserat skin the occipital crest is composed of hair principally white with black or red extremities; the rest of the mane consists of a mixture of red, black, and white hair, the red being much in evidence; also the pale patch on the anterior portion of the lower jaw is mostly red. It is on account of the almost complete absence of red from the mane and the small amount on the jaw of the Selangor specimen that I regard it as representing a geographical race of Serow, distinct from *C. s. swettenhami*.

It is important here to repeat Mr. Butler's statement that a dead specimen seen by Mr. L. Wray, a living specimen seen by himself in the jungle, and a stuffed young one together with the type in the Perak Museum are alike, to all intents and purposes, in colour. Including, therefore, the example from Biserat in the British Museum, no fewer than five skins have been examined and reported upon. This is sufficient to justify the conclusion as to the constancy of the characters upon which *C. s. swettenhami* was based and to warrant the view that the Selangor form described above must be regarded as distinct.

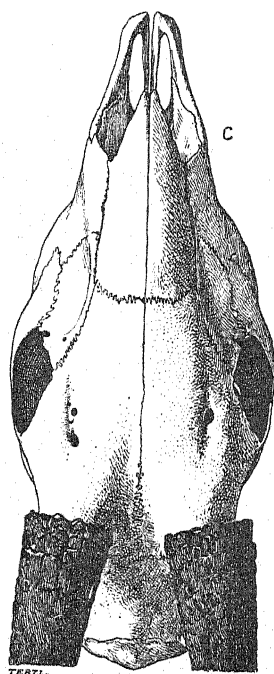
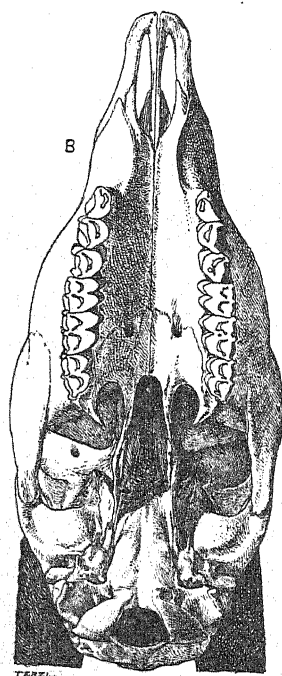
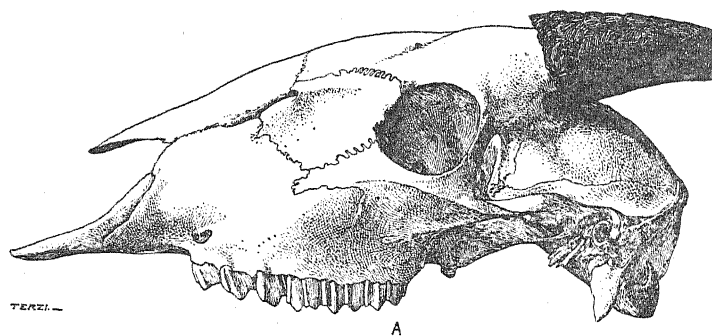
I learn from Mr. H. C. Robinson, F.Z.S., the Curator of the Selangor State Museum, that this Serow was surprised in a patch of scrub near Batu on the coast of Selangor, and driven by dogs into the sea, where it was captured. There are no hills of more than two or three hundred feet in height for many miles from the spot where it was first discovered, the district towards the coast being mostly swampy land. The Serow must have wandered either from the range of hills between Negri Sembilan and Selangor, which jut off from the main backbone of the Peninsula of Malacca, or possibly from the latter range itself.

The animal was kept alive by natives for three months before it was shipped for London. It arrived in a very emaciated condition and died after a few weeks from starvation, caused by the blocking of the pylorus with masses of thickly felted soft woolly hair. That this was not derived from the animal itself is rendered probable by the absence of all underfur to the coat. It seems possible, therefore, that the animal devoured a blanket, or a piece of woollen cloth, during the time of his captivity with the natives.

The skulls of the typical *C. s. sumatraensis* and of *C. s. swettenhami* are unknown to me; but that of *C. s. robinsoni* differs in certain well-marked features from the skulls of all the Himalayan and Burmese specimens that I have been able to examine in the British Museum. It is long, narrow, and high, the frontals being unusually elevated and convex both antero-posteriorly and transversely between the orbits, so that the plane of the horns lies in almost the same line as the plane of the face, and the downward slope of the cranium posteriorly is somewhat abrupt. The facial or lacrymal fossa is shallow. The nasals also are



## Text-fig. 36.



Skull of *Capricornis sumatraensis robinsoni* Poc., belonging to the specimen shown in text-fig. 35. (B.M. Reg. 6.11.4.1.)

A, from the side; B, from below; C, from above.

transversely convex and long. Regarding the skull from its ventral aspect, it is evident that the basi-facial axis is more bent upon the basi-cranial axis than in other specimens. The horns are short and thick, the sheath measuring only 160 mm. ( $6\frac{1}{2}$  inches) with a basal circumference of 125 mm. (5 inches).

Subjoined is a table of measurements of four skulls of Serows from Kashmir, Nepal, Chamba, and Selangor.

*Skull-measurements in millimetres \*.*

	Kashmir.	Nepal.	Chamba.	Selangor.
† Basal length from occipital suture to distal end of premaxillæ ....	215	211	223	210
Width across zygomata .....	130	128	127	117
"    "    maxillæ .....	98	98	98	102
"    "    between orbits .....	93	87	78	81
Median length of frontal .....	112	105	112	118
"    "    nasal .....	94	93	73	103
Width across nasals .....	50	47	41	48
Width across premaxillæ (maximum).....	53	51	50	54
Width across premaxillæ (distal end) .....	32	31	26	27
Height from alveolus of molar 2 to summit of frontals .....	104	94	98	114
Height from alveolus of premolar 3 to summit of nasals.....	94	84	90	103
Length of cheek-teeth .....	90	87	93	92
Length and width of last molar ...	20, 13	20, 16	20, 12	21, 13
Median length of palate to distal end of premaxillæ .....	162	167	148	161
Width of palate between last molars .....	60	52	57	50
Width of palate between first premolars .....	41	38	38	38

In spite, however, of the differences above set forth, I think it premature to attach very much weight to them and to draw conclusions as to their constancy until the extent of the variations of the skull with age, possibly with sex, and in a number of individuals from the same locality, has been ascertained. These remarks apply more particularly to the specimens from the Himalayas, of which the dimensions are tabulated above. The explanation of the differences, for example, between the Kashmir and Nepal skulls may be a matter of age if the skull becomes flatter, narrower in the palate, and deeper in the preorbital pit with advance of years‡. It is significant that one of the skulls

\* Measurements taken with a compass or dividers.

† This measurement is taken from the basioccipital suture instead of from the occipital foramen, because the occipital region of the skull is not infrequently absent in prepared skulls.

‡ Implicit faith in the systematic value of cranial and dental differences, coupled with inexperience in osteology and injudicious handling of material, seems to have been responsible for the vast numbers of "species" into which the Deer, Pigs, and Antelopes, including Serows and Gorals, of Southern China have been split by Père Heude.

brought by Hodgson from Nepal is intermediate, or nearly so, between two others from that country and the one from Kashmir. The skull from Selangor, however, can be at once singled out from the others by its general aspect and dimensions.

The seven geographical races of Serow (*Capricornis sumatraensis*) discussed above may be distinguished externally as follows:—

- |  |                      |
|--|----------------------|
| a. Legs below the knees and hocks white, whitish, or fawn and lighter than the area above these joints*.   |                      |
| b. Head pale chocolate-brown, not appreciably intermixed with black .....  | <i>humei.</i>        |
| b'. Head black or brownish black.  |                      |
| c. Breast and under side white, and sharply defined from the dark colour of the rest of the body, which is covered with a thick coating of long black hair tinged with red; underfur conspicuous; a distinct and large white patch on the throat ..... | <i>rodoni.</i>       |
| c'. Breast and under side at most dirty white and blending with the dark colour of the rest of the body, the hair of which is scantier and darker with little if any underfur; at most a small patch on the throat.                                    |                      |
| d. Under side dirty white or rufous white; the coat less black; lower portion of legs white or faintly tinged with fawn .....  | <i>thar.</i>         |
| d'. Under side blackish red; the coat jet-black; lower portion of legs very decidedly tinged with fawn on the cannon-bone .....  | <i>jamrachi.</i>     |
| a'. Legs below the knees and hocks black, not lighter than area above these joints†  |                      |
| e. Scarcely any red in the mane and on the white patch on the under jaw.   |                      |
| f. Mane for the most part hoary grey and forming a large thick mat on the withers .....  | <i>sumatraensis.</i> |
| f'. Mane less grey and not forming a large mat on the withers .....  | <i>robinsoni.</i>    |
| e'. A considerable quantity of red in the mane and on the patch on the under jaw .....   | <i>swettenhami.</i>  |

### III. *On the Goral* (*Næmohedus*) *of the Himalayas, Burma, and China.*

Up to the end of 1904 only one species of Goral was known from the Himalayas; but in the 'Zoologist' for March 1905, pp. 81-84, Mr. Lydekker correctly pointed out that two types of Goral occur in those mountains, one in the western and the other in the more eastern portions of the range, the two meeting in Nepal. To the eastern form, termed the "brown" Goral, the specific name *goral* was restricted; while the western form, termed the "grey" Goral, was described as a new species under the name

\* Not known for certain in the case of *C. s. humei*.

† Some Chinese Serows are intermediate in the coloration of the legs between *C. s. jamrachi* and *C. s. sumatraensis*. For instance, *C. s. milne-edwardsi* from Eastern Tibet has the lower legs rusty yellow, and an example in the British Museum from Sze-chuen (Berezowski), referable to *C. s. argyrochætes*, has the cannon-bone blackish in front and rufous elsewhere.

*bedfordi*. Apart from the noticeable difference in colour between the two, the "brown" Goral is further distinguished by the presence of a black spinal stripe which is absent, at least on the back and tail, in the "grey" form.

Now, *Antelope goral* was first described by Hardwicke (Tr. Linn. Soc. xiv. p. 518, 1825). The description, taken from a living animal, states that the hair was of a "grey mouse-colour (but almost white about the lower part of the neck and throat), and darker; it is longer along the upper part of the neck and back, inclining to ferruginous about the legs." Similarly the Latin diagnosis says: "Corpore supra colore murino canescente, subtus pallidiore, gula albente."

It is, in my opinion, impossible to maintain that Hardwicke can have described as "grey mouse-coloured" an animal which is *not* grey, and which was regarded independently by Hodgson as "rusty and brown"; by Dr. Blanford as "brown, more or less rufous"\*; and by Mr. Lydekker as "rufous brown." Hardwicke's use of the terms "grey" and "canescent" as applied to the body and the contrast that he draws between that colour and the inclination to a ferruginous tint on the legs make unavoidable the conclusion that the specimens upon which the specific name *goral* was based represented a form identical with or very closely allied to the one that Mr. Lydekker spoke of as the "grey" Goral and named *Orotragus bedfordi*.

It must be particularly borne in mind, too, that although Hardwicke noticed the length of the hair on the upper part of the neck and back in the type of his species, he made no mention of the presence of the black spinal stripe so conspicuous in adults of the "brown" Goral. The figure, it is true, shows such a stripe on the neck and withers; but this is sometimes present in specimens of the "grey" Goral, and is very noticeable in the living example of the latter now in the Zoological Gardens when the neck-hairs are parted.

The description of *N. goral* was taken from a male specimen living in the menagerie at Barrackpore, near Calcutta, which had been previously the property of the Court at Katmandu in Nepal; and there is a skin of a "grey" specimen in the British Museum, ticketed Nepal (Maharajah Dhuleep Singh; 55.1.20.5), which Mr. Lydekker identified as *N. bedfordi*.

For the type of *N. bedfordi*, a mounted specimen now in the British Museum (Reg. no. 97.4.3.1) and at one time the property of the Duke of Bedford, no locality was known. The specimen, however, as His Grace has kindly informed me, was imported by Mr. William Jamrach; and I learn from Mr. Jamrach that he formerly procured Gorals from Dharmasala. This circumstance and the similarity between the specimen named *N. bedfordi* and a series of skins of Gorals from Chamba, shot by H.H. the Rajah

\* This author adds "or greyish." Be it remembered, however, that he had access to the material in the British Museum containing a specimen of the "grey" Goral, which he apparently did not distinguish from the "brown" form.

of Chamba and kindly sent to me through Major Rodon, F.Z.S., point to Dharmsala as the locality of the typical example of *N. bedfordi*. This specimen Mr. Lydekker described as yellowish grey-fawn, suffused with blackish, which can be interpreted as merely another way of describing the colour which conveyed to Hardwicke the impression of "mouse-grey and darker."

But, as one of the features distinctive of *N. bedfordi*, Mr. Lydekker mentioned the large extension of the white of the interramal area up the cheek. This exists undeniably in the stuffed specimen; but one's confidence in the systematic value of the character is completely shattered by the entire absence of any indication of it in the excellent photograph of the living animal, taken by the Duchess of Bedford, which Mr. Lydekker has published\*. No one who looks at this photograph can for one moment believe that the lower part of the cheek up to or even above the level of the corner of the mouth was white or different in tint from the rest of the cheek. The upward extension, therefore, of the white in the stuffed specimen must be merely due to a taxidermic distortion, unless the colour of this region changed between the time of taking the photograph and the death of the animal, which is unlikely.

In view of the above-mentioned facts, the following conclusions appear to me to be inevitable:—(1) That the type of *N. goral* was the "grey" Himalayan form; (2) that Mr. Lydekker re-described this form as *N. bedfordi*. And from this it follows that the "brown" Himalayan Goral is up to the present time without a specific name. From the nature of the differences separating the "grey" and "brown" Gorals I think it probable that they will be found to intergrade. Up to the present, however, there is, so far as I am aware, no proof of the fact. Since the two forms have been recorded from Nepal it is possible, as Mr. Lydekker has suggested, that they occur at different altitudes in the Himalayas. Pending additions to our knowledge in these particulars, I propose to follow Mr. Lydekker in treating these Gorals as distinct species.

#### NEMCRÆTUS GORAL Hardwicke.

*Antelope goral* Hardwicke, Tr. Linn. Soc., Zool. xiv. p. 518, pl. xiv., 1825.

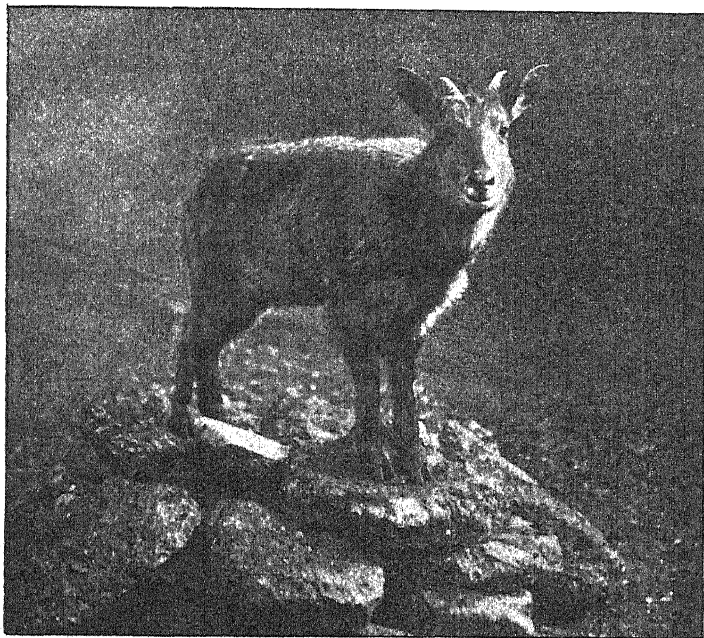
*Urotragus bedfordi* Lydekker, Zoologist, March 16th, 1905, p. 83; id. Great and Small Game of India, nov. ed. p. 151, 1907; id. in Rowland Ward's Records of Big Game, p. 343, fig. p. 348, 1907.

Prevailing colour yellowish grey, speckled or suffused to a varying extent with black, so that the depth of the tint varies considerably individually, but the pale band in the hairs is always yellowish grey and never rufous or brown. Forehead suffused with rusty yellow, the same tint traceable on the sides of the

\* 'Zoologist,' 1905, pl. i.; 'Great and Small Game of India,' p. 137, 1900; nov. ed. 1907, p. 149; Rowland Ward's 'Records of Big Game,' 1907, p. 348.

nose; cheeks grey, interramal area and chin white; upper lip white, stained with yellow at the sides. Throat-patch yellowish or snow-white, sometimes set off by a darker border; ears mouse-grey or yellowish externally. Between the horns a tuft of dark or black hair intermixed with white; usually there is no black spinal stripe either on the neck or body, but the hairs on the middle line of the neck show up as distinctly darker than the sides, owing to their partially erect position revealing the slate-grey colour of the basal portion. In one specimen, however, the

Text-fig. 37.

*Nemorhaedus goral* Hardw.

Photograph of specimen from Chumba, now living in the Society's Gardens.

hairs on the middle line of the neck and withers have long black tips, which run together to form a distinct blackish line. Tail the same colour as the back in its basal half\*, but the tip with a longish tuft of hairs black throughout. Skin of tail white below. Subcaudal area fringed with white hairs. No blackish stripe extending up the buttocks from the legs. Colour of legs very variable; fore legs usually with a well-defined black stripe

\* In Mr. Lydekker's description of *N. bedfordi* the "base" of the tail, instead of the "tip," is described as blackish.

extending down the middle from above the knee to the fetlock; but in one skin from Chamba and in the type of *N. bedfordi* the stripe is quite short and inconspicuous, except upon the knee; the sides and posterior surface of the leg below the knee varying from a rich fawn to greyish, sometimes even whitish on the inner side. Hind legs similarly variable, darker or lighter fawn down the front, sometimes showing some black hairs above the fetlock and sometimes whitish on the inside; the posterior surface from the hock always darker than the anterior, never fawn, and usually blackish. Belly and inside of thighs white or greyish, sometimes with a yellow tinge; a dark patch on the chest.

*Loc.* Chamba; ? Dharmasala and Nepal.

The above-given description is taken from a single example from Chamba now living in the Gardens, which was presented to the Society by Major Rodon, F.Z.S., on June 3, 1904, and also from a series of eight skins of specimens shot in Chamba by H.H. the Maharajah, who kindly gave them to Major Rodon to forward to me for examination and description. This series has been especially useful in showing the variation in detail, and at the same time the constancy in general appearance presented by a number of individuals from the same locality. From these Chamba skins the type of *N. bedfordi*, which probably came from Dharmasala, and the above-mentioned skin in the British Museum ticketed Nepal (Maharajah Dhuleep Singh), are not, in my opinion, separable by a single character of systematic value.

It is interesting to record that the example of this race now living in the Gardens was a quite young animal on its arrival in June 1904, and that, except for increase in size of body and length of horn, it has not appreciably altered in appearance. Nor is there any marked seasonal variation in colour, the new summer coat being merely a little richer in tint than the old coat before shedding begins.

On one occasion about a year ago this animal got into a yard where there was a well-grown specimen of a Grecian Ibex, considerably larger and more heavily built than the Goral. But, in spite of the confined space, I am quite sure that the fight that ensued would have ended fatally for the Ibex, which, although full of pluck and eagerness for the fray, seemed bewildered by the agility of his antagonist. The Goral's method of fighting was to charge low under the guard of the Ibex's heavy recurved horns, then to get out of reach, never giving the Ibex a chance of one straightforward butt, which would probably have ended the contest in his favour. Before the combatants could be separated the Goral had succeeded in wounding the Ibex in the nose with his short sharp horns. The efficacy of the short pointed horn as compared with the heavy horn in Goat-like ruminants was further exemplified some years ago by another fight that took place, I have been told by Mr. Thomson, between a male Thar (*Hemitragus jemlaicus*) and a Markhor (*Capra falconeri*). In less than five minutes the Thar killed the Markhor by getting past his

horns and ripping open his abdomen. But in this particular instance I have no first-hand knowledge of equality between the contestants in the matter of age and condition, as I have in the case of the Goral and the Ibex.

*NEMORHEDUS HODGSONI* Pocock.

Abstr. P. Z. S. No. 55, p. 12, March 17, 1908.

*Nemorhedus (Antelope) goral* Hodgson, P. Z. S. 1834, p. 85.

*Cemas goral* Blanford, Fauna of Brit. Ind., Mammalia, p. 516, 1891.

*Urotragus goral* Lydekker, Zoologist, March 16th, 1905, p. 83; id. Great and Small Game of India, nov. ed. p. 151, 1907; id. in Rowland Ward's Records of Big Game, p. 342, 1907.

*Nec Antelope goral* Hardwicke, Tr. Linn. Soc., Zool. xiv. p. 518, 1825.

General colour of type darkish golden brown speckled with black, the individual hairs dark brown at the base, black at the apex, and with an intermediate golden-brown or rufous area. Forehead and nose deep reddish brown, becoming blacker towards the root of the horns, a small black patch above the muzzle; cheeks yellowish brown, paler than body owing to the absence of the black apical tip to the hairs; interramal area not white but stained with yellow, a brown patch on the chin; lips yellowish white; throat-patch yellowish white, defined laterally by an indistinct blackish streak.

A black stripe extending from the head along the neck, where the hairs form a short mane, down the back to the root of the tail. On the neck it is about 1 inch broad, but behind the shoulder it gradually tapers away and almost disappears upon the lumbar and sacral regions. A black patch on the chest; belly greyish yellow. Tail wholly black above, except for a few pale hairs at the side. Area below the tail white above in the adanal region, yellowish below on the inside of the thighs. From near the root of the tail on each side extends a blackish-brown stripe down the back of the thigh and leg to the hock, and this is continued from the hock to the fetlock and beneath the "dew-claws" to the hoof; front of hind legs below the hock golden brown, with commonly a blackish stripe. Fore legs golden brown, with a black patch over the knee and black hairs extending in the middle line thence both below and above the knee, where the hairs are a bright, almost fiery, brown. Horns but little curved,  $4\frac{1}{2}$  inches long, corrugated and ringed basally, basal antero-posterior width  $\frac{7}{8}$  of an inch (23 mm.). Ear-cavity about  $3\frac{1}{2}$  inches long.

*Loc.* (of type). Sikhim (*W. T. Blanford*; no. 91.10.7.169 in B.M.); also Nepal (*B. H. Hodgson*).

In addition to the typical skin above described, there are in the British Museum three other skins referable, I think, to this race of Goral. They are ticketed Nepal (*B. H. Hodgson*; nos. 45.1.8.325-327). In the largest of these the general colour is



browner, with the hair less noticeably speckled than in the type, and the throat-patch and interramal area are white, the latter being a dirtier white than the former. The horns are  $3\frac{1}{2}$  inches long (90 mm.), with a basal diameter of  $\frac{3}{4}$  of an inch (20 mm.). A second example is evidently young; the fur is softer and thicker and also less speckled than in the first, and the face is less richly coloured and somewhat greyer. The third specimen, a young and hornless individual, while presenting the same general type of coloration as the others, differs from them in that the black spinal stripe fades away on the lumbar region and the tail is not black above. Hodgson's remark that the young is redder than the adult and destitute of mantle and mane is worth repeating.

A young example of this species from Nepal was presented to the Society by the Prince of Wales in June 1906, but died a few days after arrival.

#### NEMORHEDUS RADDEANUS Heude.

*Antilope (Caprina) crispa* Radde, Reisen im Süden von Ost-Sibirien, i. pp. 262-270, pl. xii. fig. 1 (nec *Antilope crispa* Temm.).

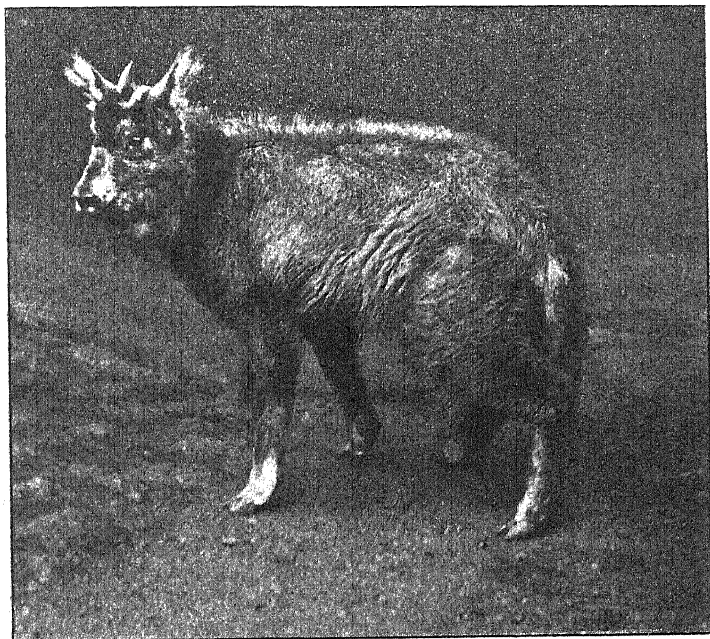
*Kemas raddeanus* Heude, Hist. Nat. Chinois, ii. p. 240, pl. 35, 1894.

General colour of the shaggy winter coat greyish yellow-brown, darker along the spinal area.

Upper surface of head blackish from the muzzle back to the occiput; sides of the head and of the lips greyish yellow mixed with black; rest of lips white; chin black. Throat with a large white gular patch. Ears white inside; pale mouse-grey, darker at the base, with brown edging externally. On the nape of the neck the hairs form a short blackish mane. On the lumbo-sacral area the dark spinal stripe is fainter than it is anteriorly. On the shoulder there is an ill-defined scapular stripe, which inferiorly turns into a jet-black stripe running down to the knee and thence over it externally nearly to the fetlock. On the inner side of the cannon-bone this is set off by a yellowish-grey stripe, which is continuous inferiorly with the yellowish-grey hue involving the front and sides of the fetlock and pastern; the posterior surface of the leg is brown, turning to black on the back of the fetlock. The hind leg is chocolate-brown from the hock to the fetlock, brownish in front, and paler yellow-brown at the sides, the pastern being creamy yellow anteriorly and laterally, like that of the fore leg. The breast and anterior part of the belly are blackish, but the groin, the inside of the thighs, and the back of the thighs up to the root of the tail are white. The tail is brown above and white below; the extremity of the tail is furnished with a mixture of long black and white hairs which extend below the hocks. The skin of the tail on its under side is about  $4\frac{1}{2}$  inches (112 mm.), and the total length of the organ to the tip of the hair is about 15 inches (375 mm.).

The length of the right horn, which is normal in position, is rather less than 5 inches (125 mm.). That of the left horn, which is bent sharply backwards in its distal half, so that the point is unworn, is  $6\frac{1}{2}$  inches (156 mm.). The basal circumference is  $3\frac{1}{4}$  inches (89 mm.).

Text-fig. 38.



*Nemorhedus raddeanus* Heude.

Photograph of specimen, from Korea, that formerly lived in the Society's Gardens.

The principal dimensions of the skull in mm. are as follows:—

Basal length .....	192
Length of palate along middle line .....	122
"    cheek-teeth .....	70
Width of palate between pms <sup>1</sup> .....	21
"    "    "    ms <sup>3</sup> .....	39
Length from pm <sup>1</sup> to tip of premaxilla .....	55
"    of nasals .....	69
Width of nasals .....	32
Interorbital width .....	69
Greatest width across orbits .....	99
"    "    "    maxillæ .....	67
"    "    of cranium .....	65

*Loc.* Korea : Wünsan (?).

A living specimen of this Goral was presented to the Society by Mr. C. F. Billborough, F.R.G.S., on Feb. 5, 1907, and died on June 30, 1907. Mrs. Billborough informed me that it "came from the high chain of mountains that runs down the whole length of Korea, rising at Wünsan to 12,000 feet high."

I cannot distinguish the skin of this Korean specimen specifically or even subspecifically from three Goral skins presented to the British Museum by Mr. Rowland Ward, F.Z.S., and ticketed "Western Provinces of China" (nos. 99.3.5.1-3 in B.M. Register): and, so far as I can judge, they are all referable to the species from Amurland, wrongly identified by Radde as *Antilope (Caprina) crispa* of Temminck, and rightly renamed *Kemas raddeanus* by Heude.

*Nemorhedus raddeanus* was regarded by Trouessart as a subspecies of *N. caudatus* M.-Edwards, presumably because of the length of the tail. In the British Museum there is a topotypical example of *N. caudatus* from Pekin, collected by Mr. F. W. Styan (Reg. no. 90.7.8.6). This specimen has the thick, long woolly coat observable in the above-mentioned examples referred to *N. raddeanus*, and the tail also is practically of the same length, as the following measurements show :—

	Skin of tail.	Tail (including hair).
<i>N. caudatus</i> (young).....	4 inches.	about 13 inches.
<i>N. raddeanus</i> (1 ♂).....	5     "	" 10     "
"     (2 ♀).....	5½     "	" 13     "
"     (3 yg.).....	4½     "	" 11     "
"     (Korea).....	4½     "	" 15     "

Nevertheless, the example of *N. caudatus*, which agrees with M.-Edwards's description and figure of the type, differs from those identified as *N. raddeanus* in having the legs below the knees and hocks almost wholly fawn-coloured in front, the fetlocks and pasterns being the same tint as the cannon-bones, and also in having the tail much blacker, both above and below. Hence there are well-marked differences between *N. caudatus* and *N. raddeanus*. Intermediates possibly, perhaps probably, exist; but until they come to hand I think it premature to regard *N. raddeanus* as a subspecies of *N. caudatus*.

The specimens from the Western Province of China exhibit variation in colour worth putting on record. The male specimen (no. 99.3.5.1) closely resembles the Korean example, being dark grey mingled with blackish brown, the upper side of the tail being of the same dark hue as the back; the fore leg is black in front down to the knee, and the outer and posterior sides of the lower leg are also black, but the fetlock and anterior and inner side of this region are white, the area above the outer false hoof being black and above the inner white. Similarly the hind legs are blackish both in front and behind, the fetlocks and pasterns being whitish

with some black hairs towards the outer side. The female, on the contrary (no. 99.3.5.2), with the same history and presumably from the same locality, is much paler, the general colour being yellowish brown, the upper surface of the tail being the same yellow-brown colour as the hind-quarters. On the fore leg the blackness scarcely extends below the knee, the blackness of the outer side of this area, so noticeable in the male, being scarcely in evidence. Similarly the hind legs are yellowish brown in front below the hocks. I do not know whether these differences are sexual, seasonal, or individual. The third specimen (no. 99.3.5.3), an immature unsexed animal, resembles the female.

So far as the coloration of the legs is concerned, the examples I refer to *N. raddeanus* are more like specimens in the British Museum from Southern China than they are like *N. caudatus*. These Southern Chinese specimens, which appear to me to be specifically the same as *N. griseus* A. M.-Edw.\*, described from Eastern Tibet, were obtained by Berezowski at Loung-nyou-fou in the mountain of Sze-chuen (nos. 96.11.4.7-8) and by Mr. F. W. Styan at Ichang on the Yangtse-kiang (nos. 1.3.2.4 and 95.7.4.1-2). A young example was also brought from the same locality by Mr. P. Montgomery (no. 96.11.4.7-8).

Except that these southern forms are covered with a thick coating of comparatively short hair and have the hairs of the tail also shorter and scantier, they do not differ very noticeably from *N. raddeanus*. The skin of the tail measures from 4 to 5 inches, and, including the hair, the entire tail may reach 10 inches. The hairs of the tail, however, are black both above and below, and in this particular resemble those of *N. caudatus* rather than of *N. raddeanus*; and the white throat-patch is tinged with yellow at the margins. The outer and posterior sides of the lower portion of the front leg are blackish, the knee, the inner side of this area, and the feet being darker or paler fawn. The hind legs, below the hock, are brown behind, fawn or greyish fawn in front.

Like *N. raddeanus*, *N. griseus* exhibits instructive variation in colour. Of the three above-mentioned skins from Ichang no two are alike. In one male example shot on September 9 the coat is poor and of a dirty yellowish brown, with a very distinct black spinal stripe, and the feet are a warm ferruginous or rusty-yellow tint. A second specimen, shot on the same date and also a male, has no distinct spinal stripe, the coat being a mixture of brown and grey. The feet are nearly white. The third specimen, also a male but shot in December, is thicker-coated and much more richly coloured with dark brown than the others, though more approaching the second specimen; the spinal stripe is traceable but less differentiated than in the first specimen, owing to the darker tint of the rest of the body; the feet are fawn—that is to

\* Nouv. Arch. Mus. vii. Bull. p. 93; Rech. Mamm. p. 361, pl. lxxi. 1874.

say, intermediate between the ferruginous tint of the first and the white tint of those of the second specimen. The edges of the throat-patch are also yellower than in the others. Since these specimens were of the same sex and from the same locality, and since the first and second were shot on the same day, it does not appear that these colour-differences are either sexual or seasonal. They are perhaps due in part to differences of age and in part to innate individual variability.

Berezowski's specimens from Sze-chuen are inseparable from the richest-coloured example from Ichang. They were shot in January. The coat is richly coloured brown and grey. In one the feet are fawn, in the other nearly white.

I cannot find any reliable character to distinguish these specimens from *N. griseus*, judging from the description and figure of the latter.

A further point to be noted is this. A Goral from Ichang was recorded by Dr. Henry as *Kemas henryanus* (P. Z. S. 1890, p. 93). This name was quoted as having been already published by Heude. But Heude's description of *Kemas henryanus* was not issued apparently until 1894, when it appeared in Mém. Soc. Hist. Nat. Chinois, ii. p. 244; and since Dr. Henry's citation was accompanied by the phrase "The Ichang animal stands as high as a Sheep," he must be regarded as the author\*. Furthermore, Dr. Sclater (P. Z. S. 1890, p. 94, note) refers the Ichang example in the British Museum, collected by Mr. P. Montgomery, to *Nemorhedus henryanus*. This Ichang Goral may possibly prove to be subspecifically distinguishable from the typical *N. griseus* when topotypical examples of the latter come to hand for comparison; but for the present I think it must be referred to that form.

Finally, I am convinced that Mr. Lydekker described the same animal as *Urotragus evansi* ('Zoologist,' (4) ix. p. 83, 1905; id. in Rowland Ward's 'Records of Big Game,' p. 343, 1907). Of this there are two cotypical examples in the British Museum from Mt. Victoria in the Pokokku district of Arakan (*Major Evans*: 5.7.21.1-2). They are quite young animals with the horns measuring only 3 inches in length. They differ in no important particulars, so far as I can ascertain, from the Ichang and Sze-chuen specimens that I refer to *N. griseus*. Moreover, in the summer of 1903 Mrs. Mumford sent to me for identification the skins of three "Goats" shot by her late husband, Mr. G. E. Mumford, District Superintendent of the Burma Police, at Kyank-pin-daung in the Arakan Hills. When compared with the material in the British Museum, these skins proved to be indistinguishable from those from Sze-chuen and Ichang, mentioned above, which I could not separate from *N. griseus*. Hence, although no new name could be introduced, the real credit of being the first to send home material showing that the Arakan Goral is distinct from the Himalayan

\* Trouessart erroneously cites *K. henryanus* as "*nomen nudum*."

animals belongs to Mr. Mumford rather than to Major Evans. Honours, however, are divided, because Major Evans's skins were perfect, whereas those belonging to Mrs. Mumford had been made into mats and were without heads and legs.

That Mr. Lydekker fell into the error of giving a new name to the Arakan Goral must be attributed to his comparing it with Himalayan specimens and not with examples from South China. Identity between Burmese and Southern Chinese animals is in no sense a surprising fact.

The following synonymy, therefore, I believe to be well established:—

*N. griseus* M.-Edwards, 1874 = *N. henryanus* Henry, 1890 = *N. evansi* Lydekker, 1905.

If my supposition that the above-mentioned Gorals from Ichang, Sze-chuen, and Arakan belong to the same species is correct, it proves that this species, whatever its name, has a wide geographical range, and presents very considerable individual variation in specimens from the same locality with respect to the colour of the body and of the feet. Indeed, when the variability in these particulars exhibited by the three examples from Ichang is taken into consideration, grave doubts must be thrown upon the status of some of the many so-called species from Southern China described by Heude.

This author, for example, described two "species" from Western Sze-chuen, namely, *Kemas* [= *Nemorhedus*] *xantho-deiros* and *K. pinchonianus*, and one from Eastern Sze-chuen, namely, *K. iodinus*\*; but, judging from the descriptions, these differ less from each other in colour than do the three skins from Ichang. It is necessary to add that Heude relied in his specific determinations largely upon characters in the skull and teeth, many of which are, I suspect, attributable to differences of age and to individual variability†.

Finally, I suspect that *N. arnouxi* Heude‡ from Tche-kiang must also be referred to the species I have determined above as *N. griseus*. So far as colour is concerned, no difference seems to exist between them, and the chief character in the skull Heude relied upon, namely the somewhat abrupt rise of the horns from the frontal bone, is also, I think, untrustworthy; for considerable variation in this respect is exhibited by the skulls of

\* Mém. l'Hist. nat. Chinois, ii. p. 243, 1894.

† Of the type of one of his "species," *N. niger*, Heude says that the discoverer informed him "*qu'elle était rare et qu'on la voyait mêlée aux troupeaux des autres espèces*" (op. cit. p. 241). Heude's apparent acceptance of this statement in good faith, and his admission that the type of *N. niger* was in the same herd as examples of *N. fargesianus*, make it impossible to accept the author's opinion as to specific differences. Two distinct species of a genus of Antelopes and Sheep sometimes run together; but such cases are quite exceptional, and in the present instance it appears to me that the evidence points to the type of *N. niger* being an aged individual of a species of which the co-types of *N. fargesianus* were younger forms.

‡ Mém. l'Hist. nat. Chinois, ii. p. 3, 1888, and *tom. cit.* p. 239, 1894; *op. cit.* iii. pl. xxix., 1897.

three specimens from Ichang in the British Museum. In one specimen, a young one collected by Mr. Styan, the horns lie back practically in the same line as the forehead; in a second obtained by the same collector they rise slightly more; and in a third sent by Mr. P. Montgomery they are still more elevated, forming an obtuse angle with the frontal bone very much as in the type of *N. armouzanus*.

The external characters of the Gorals (*Nemorhedus*), whether they be regarded as species or subspecies, discussed in the preceding pages, may be analysed as follows:—

- a. Skin of tail about 3 inches long in the adult; black stripe on fore leg extending over the middle of the knee (carpus) and usually continued thence down the middle line of the cannon-bone (metacarpus) to the front of the fetlock. (Himalayas.)
- b. Prevailing colour grey or fawn-grey, more or less suffused with black; black spinal stripe usually wholly absent, when present not passing beyond withers (shoulders); tail black at the end; no black up back of thighs ..... *goral*.
- b'. Prevailing colour brown, more or less suffused with black; black spinal stripe present in adult and sub-adult examples, and extending at least on to the lumbo-sacral area; a black stripe down the upper side of the tail and an ill-defined black stripe running up the back of each thigh from the hock ..... *hodgsoni*.
- a'. Skin of tail about 5 inches long in adult; black stripe on fore leg not passing over the middle line of the knee (carpus), but turning aside at that area and commonly continued down the outer side of the cannon-bone (metacarpus) to the outer false hoof and thence on to the back of the fetlock and pastern. (North China to Arakan.)
- c. Coat comparatively short and not woolly even in the winter; tail less bushy (tail-tuft black above and below; throat-patch more or less yellow, at least marginally)... *griseus*\*.
- c'. Coat, at least in the winter, long, shaggy, and more or less woolly; tail-tuft long and copious (throat-patch without yellow).
- d. Legs below knees and hocks nearly uniformly fawn in front and externally; tail-tuft black, much darker than the proximal portion of the organ and than the back of the body; a narrow white fringe of hairs bordering the tail below ..... *caudatus*.
- d'. Front of legs below knees and hocks to a certain but varying extent fuscous and contrasted in colour with the white or dirty-white tint of the feet; upper side of the tail the same colour as the back, but not wholly black; a broad white fringe bordering the tail below ..... *raddeanus*.

\* I suspect that *N. cinereus* A. M.-Edwards (Rech. Mamm. p. 362, pl. lxx. *et seq.*, 1874) from Eastern Tibet will prove to be at most subspecifically distinct from *N. griseus*, in spite of the differences in the skull and teeth pointed out by the describer. By Trouessart (Cat. Mamm. Suppl. p. 734, 1905) both of these Gorals are erroneously classified with the Serows.

April 7, 1908.

Dr. HENRY WOODWARD, F.R.S., Vice-President,  
in the Chair.

On behalf of Mr. Thomas Codrington, Dr. A. Smith Woodward, F.R.S., F.Z.S., exhibited a collection of 168 stones, weighing altogether 7 lbs. 13 oz., taken from the stomach of an Elephant shot by Mr. H. Thornicroft in Northern Rhodesia. The animal was a large male, with tusks weighing 45 lbs. each. The stones showed no signs of attrition.

Dr. C. W. Andrews, F.R.S., F.Z.S., exhibited a restored model of the skull and mandible of *Prozeuglodon atrox* And. This animal is one of the links uniting the true Zeuglodonts with the land Creodonts. It is found in the Middle Eocene of Egypt, where also the earlier type, *Protocetus*, was discovered by Fraas at a somewhat lower horizon. The model was constructed by Mr. F. O. Barlow, for the British Museum of Natural History.

The Secretary exhibited a photograph of two young living

Text-fig. 39.



Young Forest-Pigs (*Hylochaerus meinertzhageni*).

examples of the Forest-Pig of Central Africa (*Hylochaerus*



*meinertzhageni* Thomas). The photograph (text-fig. 39) had been taken by Mr. T. J. Morson, of Limoru, who had obtained the pigs in the Limoru escarpment forest about 353 miles from Mombasa, at an elevation of between seven and eight thousand feet.

The Secretary stated that he had been informed by the High Commissioner for New Zealand, that the Chamois presented by the Emperor of Austria to New Zealand, and which had been successfully taken to New Zealand by one of the Society's staff in the beginning of 1907, had been seen in the locality in which they were liberated, one of the females being accompanied by a strong, healthy-looking kid.

The following papers were read :—

1. A Monograph of the Chiropteran Genera *Uroderma*, *Enchisthenes*, and *Artibeus*. By KNUD ANDERSEN.

[Received May 29, 1907.]

(Text-figures 40–59.)

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The dentition of *Artibeus planirostris*, p. 205.

<i>Uroderma</i> , p. 212.	<i>A. j. lituratus</i> , p. 272.
<i>U. bilobatum</i> , p. 217.	<i>A. j. palmarum</i> , p. 278.
<i>U. thomasi</i> , p. 221.	<i>A. j. præceps</i> , p. 283.
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<i>A. p. planirostris</i> , p. 237.	<i>A. rosenbergi</i> , p. 293.
<i>A. p. trinitatis</i> , p. 241.	<i>A. toltecus</i> , p. 296.
<i>A. p. grenadensis</i> , p. 241.	<i>A. t. toltecus</i> , p. 297.
<i>A. p. fallax</i> , p. 242.	<i>A. t. rarus</i> , p. 300.
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<i>A. jamaicensis</i> , p. 247.	<i>A. phaeotis</i> , p. 303.
<i>A. j. parvipes</i> , p. 261.	<i>A. aztecus</i> , p. 306.
<i>A. j. yucatanicus</i> , p. 263.	<i>A. turpis</i> , p. 307.
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Wing-indices, p. 310.

Summary of characters of genera, species, and subspecies, p. 311.

General remarks :—

- (a) Artificial and natural arrangement of the species of *Artibeus*, p. 314.
- (b) *A. planirostris* and its races, p. 316.
- (c) The races of *A. jamaicensis*, their distribution, and its bearing on a past connection of the West Indies and Central America, p. 317.

The conclusions recorded in this paper are based on a study of 485 Bats (361 skulls) of the genera *Uroderma*, *Enchisthenes*, and

*Artibeus*\*. 272 of these specimens (218 skulls) form part of the collections of the British Museum; the rest, 213 specimens (143 skulls), were placed at my disposal, for inspection and identification, by the Authorities of the United States National Museum.

The British Museum series is particularly rich in South and Central American, the Washington series in Mexican and West Indian specimens. Thus the two collections admirably supplement each other.

I wish to tender my grateful thanks to Mr. Oldfield Thomas for the opportunities he has so kindly afforded me for continuing my Chiropteran studies in the British Museum. To Dr. J. Leisewitz, Munich, Dr. Marcus W. Lyon, Washington, and Professor D. G. Elliot, Chicago, I am indebted for information on typical specimens in the collections under their charge.

#### THE DENTITION OF *ARTIBEUS PLANIROSTRIS*.

The teeth of one species only, viz., *Artibeus planirostris* (subsp. *fallax*) are described in detail in this paper, the description of the dentition in the other forms being, as a rule, confined to those points in which it differs from this paradigma.

*On the denomination of the molar cusps.*—The molar cusps are named in accordance with Herluf Winge's theory†. The three cusps (labial in the upper, lingual in the lower jaw) forming the tips of the **W** of a typical molar in insectivorous bats are termed, in antero-posterior direction, respectively 1, 2, 3, cusp 2 being probably the oldest, homologous with the single cusp of a Reptilian tooth; the two cusps forming the bases of the **W** are named 4 and 5; the "heel" of the upper molars, when single, cusp 6, when double, cusps 6 and 7. See text-figs. 40, 41, pp. 207, 208.

*Tooth formula.*—
$$\begin{array}{ccccccc} i^1 & i^2 & - & c & - & p^3 & p^1 & m^1 & m^2 & m^3 \\ i_1 & i_2 & - & c & p_1 & - & p_1 & m_1 & m_2 & m_3 \end{array}$$

*Remarks on the tooth formula.*—No known bat has more than two pairs of upper incisors. The generally accepted hypothesis is that the permanently missing pair is  $i^1$ ; but, in my opinion, the balance of evidence is decidedly in favour of the view that  $i^3$ , not  $i^1$ , has been lost. The former hypothesis ( $i^1$  lost) is generally supported by two arguments, viz., "by the correspondence of the two upper teeth with the two outer of the lower jaw when the maximum set is present," and "even more strongly by the general tendency throughout the group [i. e., the Chiroptera] for the premaxillaries to become reduced, particularly along the inner edge"‡. As to the former argument, it proves

\* Brief preliminary diagnoses of the genus *Enchisthenes* and ten new forms of *Artibeus* and *Uroderma* were published in the Ann. & Mag. Nat. Hist. for December 1906 (pp. 419-423).

† Herluf Winge, Om Pattedyrenes Tandskifte, især med Hensyn til Tændernes Former (Vidensk. Meddel. Naturhist. Foren. Kjøbenhavn for 1882, pp. 15-69, pl. iii.).

‡ Gerrit S. Miller, Jr., 'The Families and Genera of Bats,' p. 27 (1907).

nothing or, if preferred, anything; attempts to determine the homologies of teeth in Mammalia on the basis of the correspondence of the upper with the lower teeth, or *vice versa*, would in too many cases lead to obviously absurd results. As to the latter argument, it seems to me, on closer examination, to lead to precisely the opposite conclusion. The tendency for the premaxillaries to become reduced along their inner edge is first developed in the higher of the two suborders of Bats, the Microchiroptera; in the Megachiroptera no such tendency obtains, and nevertheless they have only two pairs of upper incisors. When, therefore, one pair has been lost also in those primitive bats in which the premaxillaries have not been reduced along their inner edge, the loss of this pair must evidently be due to some other reason. The strong lower canines in bats (or rather their ancestors) have probably effected the degeneration, and ultimate disappearance, of that pair of upper incisors which, if it were present (or present in its full size), would hinder their free passage in front of the upper canines; in other words, in passing in front of the upper canines the lower canines have checked the growth, and ultimately caused the complete disappearance, of  $i^1$ . In accordance with this we find in most Megachiroptera the four upper incisors ( $i^2$   $i^1$   $i^1$   $i^2$ ) close together, but  $i^2$  separated by a wide diastema from the canine; part of this diastema indicates the former place of  $i^3$ , but it has no doubt been widened to allow of the free action of the lower against the upper canines. In many genera of Microchiroptera, this line of development has been carried a step further; by a narrowing of the diastema between  $i^2$  and  $c$  the former has come closer to the latter and within reach of the lower canines, which then cause a decrease in size (and change in shape) of  $i^2$ . This is the case in the three genera which form the subject of the present paper, and which, therefore, in showing what actually *takes* place, in living bats, with regard to  $i^2$ , give, so to say, an illustration of what *has* probably taken place, in the ancestors of bats, with regard to the now permanently lost  $i^3$ .

A large number of Chiropteran genera (some 60 out of the now recognised 173 genera) have three pairs of lower incisors; in most of these genera the lower incisors are subequal in size; in those few in which one pair is noticeably, or even considerably, reduced, this pair is  $i_3$  (compare f. i. *Rhogeessa*, *Neodon*, some species of *Nyctinomus*, *Mormopterus*). From this it appears safe to assume that in bats which have only two pairs of lower incisors, the missing pair is  $i_3$ .

No bat has more than three premolars, above and below. As recently pointed out by Oldfield Thomas\* the permanently missing upper and lower premolar is in all probability  $p^2$  and  $p_2$  (not, as hitherto taken for granted,  $p^1$  and  $p_1$ ).

In those Phyllostomatidae which have three upper premolars

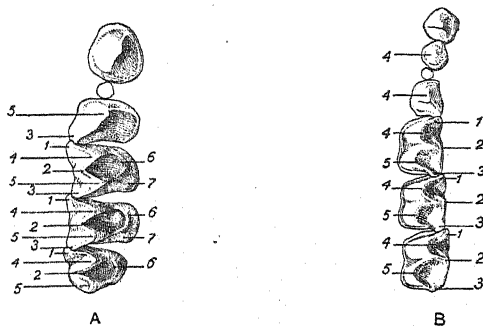
\* Oldfield Thomas, "The Missing Premolar of Chiroptera," Ann. & Mag. N. H. (8) i. pp. 346-348 (April, 1908).

(*Lonchoglossa* f. i.)  $p^1$  is the smallest. From this it is concluded that the upper premolar lost in Stenodermatous bats is  $p^1$  (not, as in Rhinolophidae,  $p^3$ ).

$p_3$ , if present in Phyllostomatidae, is generally smaller than  $p_1$  and  $p_2$  (compare f. i. *Micronycteris*). From this it is concluded that the lower premolar lost in Stenodermatous bats is  $p_3$ , not  $p_1$ .

*Upper incisors* (text-figs. 41 A, D).—Inner pair bifid, the two cusps subequal in length (the inner one generally a trifle longer); front face plane or faintly convex, with slightly wrinkled enamel; hinder face strongly concave in direction from above downwards, the lower half of the crown of the tooth therefore somewhat chisel-shaped. Outer pair as broad as inner pair, but much shorter; cutting-edge simple (not bifid), oblique; front face as well as hinder face concave from side to side. The reason why the outer is considerably shorter than the inner incisor, and its cutting-edge

Text-fig. 40.



*Rhinolophus trifolius*, ♀ ad. Singapore. B.M. 4.8.23.1.

A. Right upper, B. Left lower tooth-row, exclusive of incisors; as a paradigma of structure of molars in insectivorous bats, for comparison with dentition of *Artibeus*, text-fig. 41.  $\times \frac{1}{4}$ .

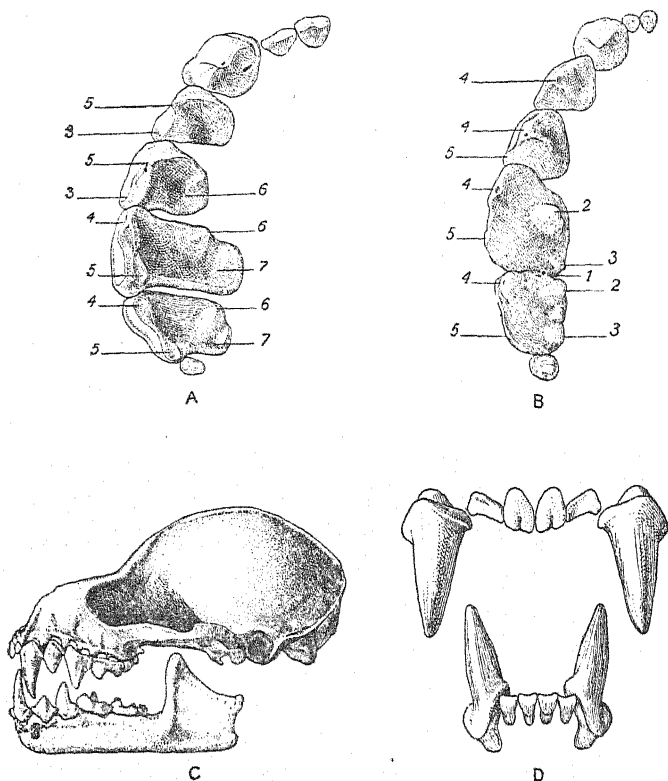
For explanation of lettering of cusps (1, 2, 3, 4, 5, 6, 7) see text, p. 205.

differently shaped, will be readily understood when studying the way in which the lower work against the upper teeth:—the long and very strong lower canines pass in front of the outer upper incisors, completely covering their front face, with exception of their narrow inner margin (text-fig. 41 D); this circumstance it is which has effected a decrease in the size of the outer incisors, made their front face concave (by constant wear against the tips of the lower canines), and the inner tip of the cutting-edge (next to inner incisors), which is less exposed to the pressure of the lower canine, longer than the outer tip of the cutting-edge (next to the upper canines), which is most exposed to the pressure of the lower canine.

*Lower incisors* (text-figs. 41 B, D).—All four teeth subequal in

breadth and height (the outer pair, if anything, faintly shorter); antero-posterior diameter of crown much greater than transverse diameter; front face slightly concave from side to side, as is also the cutting-edge; this latter circumstance gives the teeth in front view a slight indication of a bifid shape.

Text-fig. 41.



*Artibeus planirostris fallax*, ♀ ad. Kanuku Mts., British Guiana.  
B.M. 1.6.4.60.

A. Right upper, B. Left lower tooth-row; C. Side view of skull and mandible;  
D. Front view of incisors and canines. A, B, D  $\times \frac{1}{2}$ , C  $\times \frac{3}{4}$ .

For explanation of lettering of cusps (1, 2, 3, 4, 5, 6, 7) see text, p. 205.

*Upper canines* (text-figs. 41 A, D).—Very long; cingulum low, terminating abruptly in front and behind, but not developing distinct secondary cusps; on the lingual face of the canine the cingulum is somewhat expanded, forming a noticeable shelf-like projection; against this expansion of the cingulum works the principal cusp (cusp 4) of the lower  $p_1$ . Hinder margin of canine

sharp, inner margin (next to incisors) rounded, lingual face almost plane. It is the constant rubbing of the labial face of  $p_1$  against the lingual face of the upper canine which has made this latter sharp on its hinder margin and almost plane on its lingual face.

*Lower canines* (text-figs. 41 B, D).—Very long; on the inner margin of the tooth, next to the incisors, the cingulum extends only as high as (or very little higher than) the level of the cutting-edges of the incisors, and does not form a secondary cusp (compare *Uroderma*); at the base of the hinder margin the cingulum forms a conspicuous shelf-like projection, caused by the constant working of the tip of the upper canine against this part of the cingulum of the lower canine.

$p^3$  (text-figs. 41 A, C).—Cusps 1 and 2 are entirely wanting. Cusp 3 is represented by a small (but quite distinct), backwardly projecting prominence at the postero-external base of the tooth. Cusp 4 has disappeared. The principal cusp—large, trenchant, raised to about half the height of the canine, very obliquely triangular, its front margin only about half the length of its hinder margin—is cusp 5. The size and shape of this cusp are correlated to the large, very obliquely triangular interspace between the principal cusp (4) of  $p_1$  and  $p_4$ ; its front margin is precisely of the same length as the hinder margin of cusp 4 of  $p_1$ , against which it works, and its hinder margin is of the same length as the front margin of cusp 4 of  $p_4$ , against which it works.—The tip of the powerful cusp 4 of the lower  $p_1$  working against the lingual cingulum of  $p^3$  has caused this latter to develop a rather strong, somewhat concave projection ("heel," representing cusp 6); also in the unworn  $p^3$  the deep, pit-like depression caused by the tip of cusp 4 of  $p_1$  is very noticeable. The anterior margin of the heel of  $p^3$  is high, prominent, sharp, acting against the trenchant hinder margin of cusp 4 of  $p_1$ .

$p^4$  (text-figs. 41 A, C).—Longer at base, much higher and broader (transversally) than  $p^3$ , but in many important details of its structure formed after a similar pattern, though on the whole less reduced in size. Cusps 1 and 2 entirely wanting (as in  $p^3$ ). Cusp 3, rather less reduced than in  $p^3$ , is represented by a low trenchant margin at the postero-external extremity of  $p^4$ . Cusp 4 (wanting in  $p^3$ ) is present as a mere rudiment at the anterior extremity of the tooth. The principal cusp—still more powerful than in  $p^3$ , the highest cusp in the upper postcanine series, trenchant, with the outline of an equilateral triangle—is cusp 5; its shape is remarkably like that of cusp 4 of  $p_4$ , against the hinder margin of which it works; the strong antero-external cusp (cusp 4) of  $m_1$  acting upon the lingual face of cusp 5 of  $p^4$  has made this latter somewhat concave in antero-posterior direction.—The whole anterior portion of  $m_1$  (its cusp 4 and the rudiment of cusp 1, when this latter has not completely disappeared) acting upon the lingual cingulum of  $p^4$  has caused this latter to develop a "heel" (cusp 6), broader and a little more complicated than in  $p^3$ ; the heel is broader, because it is acted upon by the broad anterior portion of  $m_1$ ,

whereas in  $p^3$  the heel is acted upon only by the pointed cusp 4 of  $p_4$ ; the tip of cusp 4 of  $m_1$  has made a deep, pit-like impression on the heel of  $p^1$ , just at the median point of the labial base of cusp 5; also the high, slender, coniform cusp 2 of  $m_1$  rubs against the heel of  $p^1$ , viz., against its postero-internal margin, which by this pressure is kept low and rapidly worn somewhat concave. The anterior margin of the heel of  $p^1$  is, like the corresponding margin of  $p^3$ , rather high, prominent, and sharp, for a similar reason: it fits into and works against the trenchant commissure between cusps 4 and 5 of the lower  $p_1$ ; on the antero-internal margin of the heel of  $p^1$  is seen a small, but quite distinct, triangular, rather blunt cusp, produced by the small cusp 5 (and its commissure with cusp 4) of the lower  $p_1$  which catches and works against it on its labial side.

$p_1$  (text-figs. 41 B, c).—Small, "diamond"-shaped, slightly longer than high. The size and shape of its principal cusp (cusp 4) are correlated to the size and shape of the triangular interspace between the tip of  $p^3$  and the upper canine; cusp 4 and a rudimentary cusp at the front end of the tooth (probably representing cusp 1) work against the lingual face and cingulum of the upper canine and the front margin of cusp 5 of  $p^3$ . The hinder margin of cusp 4 (together with a small, pointed, straightly backwardly extending prominence of the posterior margin of its base, perhaps representing cusp 5) work against the projecting anterior margin of the heel of  $p^3$ . The lingual cingulum of  $p_1$  is slightly expanded.

$p_4$  (text-figs. 41 B, c).—Viewed from the external side rather closely resembling the upper  $p^4$  in shape and size. Cusp 4 is large, triangular, equilateral, by far the highest cusp in the post-canine series; it works against the lingual face and posterior margin of cusp 5 of  $p^3$ , the front margin of cusp 5 of  $p^1$ , and the heel of  $p^3$ , on which its tip has produced a deep depression. A triangular emargination of the commissure between cusp 4 and the rudimentary cusp 5 (this latter situated at the postero-external corner of the tooth) has been produced by the elevated anterior margin of the heel of  $p^4$ , which fits into this emargination. The small cusp 5 catches the labial side of, and works against, the small antero-internal cusp on the front margin of the heel of  $p^4$ . The lingual, low, and cingulum-like portion of the tooth is rather larger than in  $p_1$ , chiefly owing to its action against the front of the heel of  $p^4$ ; there can be little doubt that this lingual portion of  $p_4$ , like the corresponding portion of  $p_1$ , in fact represents the degenerated cusp 2 (compare the lower premolars in insectivorous bats).

$m^1$  (text-figs. 41 A, c).—Enormously expanded in transversal direction, its breadth being about  $1\frac{1}{2}$  its length at the labial margin; considerably shorter at lingual than at labial margin. Cusps 1, 2, and 3 have entirely disappeared. The external, trenchant margin of  $m^1$  is formed anteriorly by the triangular cusp 4, rising to about half the height of the principal cusp of  $p^4$ , posteriorly by the much lower, obliquely triangular cusp 5; cusp 4

works against the posterior margin of cusp 4 and the anterior margin of cusp 5 of the lower  $m_1$ , cusp 5 against the posterior margin of cusp 5 of  $m_1$  and the whole of cusp 4 of  $m_2$ . At the antero-internal corner of the heel of  $m^1$  (at level with the lingual margin of the heel of  $p^1$ ) is seen the low, but strong, triangularly projecting cusp 6; it fits into a depression in  $m_1$ , immediately behind cusp 2 of this latter tooth, and has checked the growth of cusp 3 of  $m_1$ , which consequently has become quite rudimentary. The large postero-internal, inwardly projecting lobe of  $m^1$  represents cusp 7. The whole lingual portion of  $m^1$ , bordered externally by cusps 4 and 5, in front by cusp 6, internally by the lingual margin of cusp 7, and behind by the very low posterior margin of the tooth, forms a large crushing surface, the enamel of which is densely wrinkled and extends on the lingual face of cusps 4 and 5 almost to their tips, thus forming an "inner cingulum" to these cusps. This crushing surface consists chiefly of two concavities; the one, bordered externally by cusps 4 and 5, internally by cusp 6, wears against the whole posterior portion (cusps 3 and 5) of  $m_1$ ; the other, immediately behind cusp 6 and the somewhat projecting antero-internal margin of cusp 7, is acted upon by the high, slender, conical cusp 2 of  $m_2$ .

$m^2$  (text-figs. 41 A, c).—Broader than long, but not so broad as  $m^1$ ; the elements are the same as in  $m^1$ , but their arrangement somewhat different. Cusps 4 and 5 strong, but much lower than in  $m^1$ . The shape and size of cusp 4 is determined by that portion of the lower  $m_2$  against which it has to work, viz., the hinder margin of cusp 4 and the front margin of cusp 5. Cusp 5 is not (as in  $m^1$ ) situated in a line immediately behind cusp 4, but has moved to the middle of the posterior margin of the tooth, where it forms a strong, backwardly projecting tubercle; this shifting of the position of cusp 5 has been necessitated, because it has to work against the hinder margin of cusp 5 of  $m_2$  and the small  $m_3$ . Cusp 6 has almost exactly the same position, shape, and size as in  $m^1$ ; it acts upon the anterior and external face of cusp 3 of  $m_2$ . Cusp 7, which in  $m^1$  is so enormously developed, is in  $m^2$  quite small, represented by a low, but perfectly distinct shelf at the postero-internal corner of the tooth; its small size is easily understood when seeing that it has to work only against the posterior margin of cusp 3 of  $m_2$  and the front of the very small  $m_3$ . The median portion of  $m^2$  forms a large crushing surface, the enamel of which is densely wrinkled, as in  $m^1$ , and produced into a distinct inner cingulum to cusps 4 and 5. This crushing surface is deeply hollowed out in the middle, owing to the strong pressure of the whole posterior portion (cusps 3 and 5) of  $m_2$ .

$m^3$  (text-figs. 41 A, c).—Rudimentary, as small as a lower incisor (scarcely  $\frac{1}{15}$  the size of  $m^2$ ). The tooth has been pushed postero-internally to  $m^2$ , pressed into an angular emargination between cusps 5 and 7 of this latter tooth; its elements cannot be discriminated. Quite functionless the tooth is not; its antero-internal portion is acted upon by the posterior portion of the small lower



$m_3$ ; but its postero-external portion cannot, so far as I can see, be touched by  $m_3$ .

$m_1$  (text-figs. 41 B, C).—Longer than broad, abruptly narrowed in front. Cusp 1 practically wanting; in some specimens of *A. planirostris* (and, more often, in *A. jamaicensis*) a faint trace of cusp 1 is detectable, as an excessively small prominence, immediately in front of cusp 2, but generally it has entirely disappeared and only its commissure with cusp 4 been partly preserved; it is the constant pressure of this portion of  $m_1$  against the anterior margin of the heel of  $p^1$  which has caused the disappearance of cusp 1. Cusp 2 strongly developed, as a high slender cone, situated very near the middle of the labial margin, close to, but not contiguous with, the cingulum; this cusp works against the postero-internal portion of the heel of  $p^1$ , which it has pressed low and concave. Cusp 3, at the postero-internal corner, extremely small, barely projecting above the level of the cingulum, acts against the hinder face of cusp 6 of  $m^1$ . Cusp 4 (antero-externally) long, but low, triangular, trenchant, acting against the heel of  $p^1$ ; the action of this cusp is the chief cause of the strong development of the heel of  $p^1$ . Cusp 5 (postero-externally) long, much lower than cusp 4, only slightly projecting, triangular; it works against the external half of the crushing surface of  $m^1$  (the depression bordered by cusps 4–5 and cusp 6 of this tooth). The enamel of the crushing surface of  $m^1$  is densely wrinkled.

$m_2$  (text-figs. 41 B, C).—Slightly smaller than  $m_1$ , subrectangular, a little longer than broad. Cusp 1 is represented by a very small (but distinct) tubercle at the middle of the front margin of the tooth. Cusp 2, antero-internally, quite of the same shape as the corresponding cusp in  $m_1$ , only slightly lower; the action of this cusp is the chief cause of the strong development of cusp 7 in  $m^1$ . Cusp 3, postero-internally, quite small, but not so strongly reduced as in  $m_1$ ; it acts against the postero-external face of cusp 6 and the front of cusp 7 of  $m^2$ . Between cusps 2 and 3 the cingulum has developed an exceedingly small supplementary cusp. Cusps 4 and 5 very similar to the corresponding cusps of  $m_1$ , but much lower; the former acts against the posterior portion of the crushing surface of  $m^1$  (lingually to cusp 5), the latter against the large crushing surface of  $m^2$  (between cusps 4 and 5 externally, and cusp 6 internally), which it has made deeply concave. Crushing surface of  $m_2$  wrinkled as in  $m_1$ .

$m_3$  (text-figs. 41 B, C).—Rudimentary,  $\frac{1}{8}$ – $\frac{1}{10}$  the size of  $m_2$ . Cusps 2 and 4 are rather easily detectable. It works against the postero-internal margin of  $m^2$  and the antero-internal portion of the rudimentary  $m^3$ .

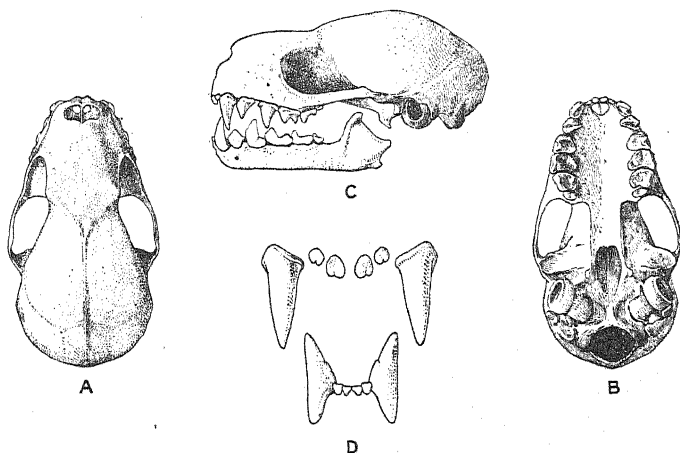
#### URODERMA Pet.

1865. *Uroderma* Peters, MB. Akad. Berlin, pp. 587–88, footnote.—Type: *Phyllostoma personatum* Pet. 1865 (not Wagner) = *Uroderma bilobatum* Pet. 1866.  
 1878. *Artibeus* Leach (partim), Dobson, Cat. Chir. Brit. Mus. p. 514.  
 1901. *Uroderma* Pet., Rehn, Proc. Ac. Nat. Sci. Philad. 1900, p. 757 (9 Febr. 1901).—Remarks on the genus.

The subjoined characterisation is confined to the points in which *Uroderma* differs from *Artibeus*.

*Skull* (text-fig. 42, compare fig. 43).—Long and slender, in general shape somewhat recalling a *Putorius nivalis* skull.—Rostrum but

Text-fig. 42.

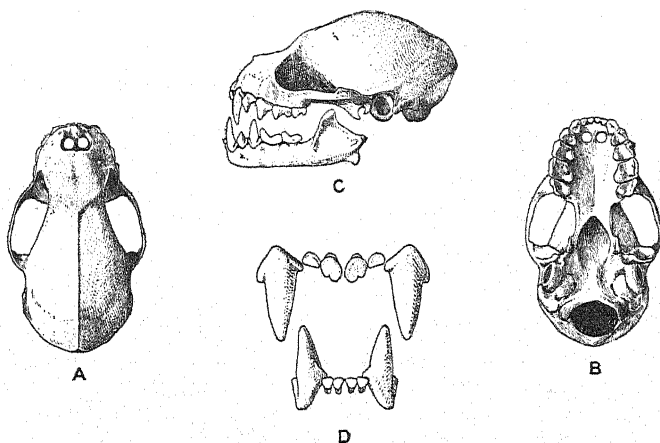


*Uroderma bilobatum*, ♀ ad. Para. B.M. 1.7.19.4.

Upper, lower, and side view of skull; front view of incisors and canines.

A, B, C  $\times \frac{3}{2}$ , D  $\times \frac{1}{2}$ .

Text-fig. 43.



*Artibeus cinereus cinereus*, ♂ ad. Para. B.M. 1.7.19.3.

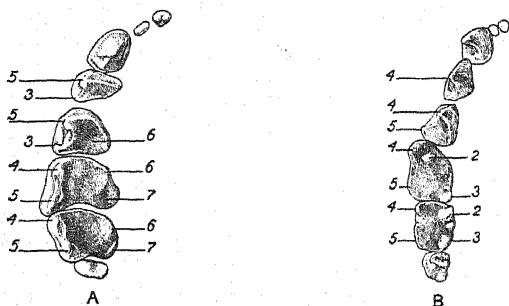
Upper, lower, and side view of skull; front view of incisors and canines (for comparison with *Uroderma*). A, B, C  $\times \frac{3}{2}$ , D  $\times \frac{1}{2}$ .

very slightly depressed; profile of skull, therefore, showing an almost straight line from the highest point of the brain-case to the tip of the nasals (text-fig. 42 c); height of rostrum at  $p^4$  greater than, or at least equal to, width of skull at "postorbital" constriction (immediately behind postorbital processes or their rudiments). In *Artibeus* the rostrum is considerably more depressed and flattened; the outline in profile, from the front of the sagittal crest to the base of the nasals, steep (text-fig. 43 c); the height of the rostrum at  $p^4$  considerably less than the width of the postorbital constriction.—Bony palate long: distance from palation to front of incisors very nearly equal to zygomatic width of skull (text-fig. 42 b); in *Artibeus* much less than zygomatic width (text-fig. 43 b).—Median backwardly extending portion of bony palate (behind  $m^3$ ) long, equal to the combined length (externally) of  $m^1$  and  $m^2$ ; in *Artibeus* much less than this latter, often only equal to the length of  $m^1$ .—Anterior nasal opening less oblique, looking chiefly forwards; in *Artibeus* noticeably more oblique, looking upwards and forwards.

*Teeth* (text-figs. 44 and 47).—Chief characters, as compared with the teeth of *Artibeus* (see text-figs. 46, on p. 215, and 48, on p. 216):—outer upper incisors bifid; cusp 2 in  $m_1$  small and more anterior in position;  $m^3$  and  $m_3$  always present;  $m^3$  situated direct behind (not postero-internally to)  $m^2$ , and almost as broad as the hinder border of this latter.—The details are these:—

(1) Cutting-edges both of inner and outer upper incisors bifid (text-fig. 42 d, on p. 213); in *Artibeus*, inner incisors bifid, outer incisors simple (text-fig. 43 d, on p. 213).—(2) The cingulum of

Text-fig. 44.



*Uroderma bilobatum*, ♀ ad. Para. B.M. 1.7.19.4.

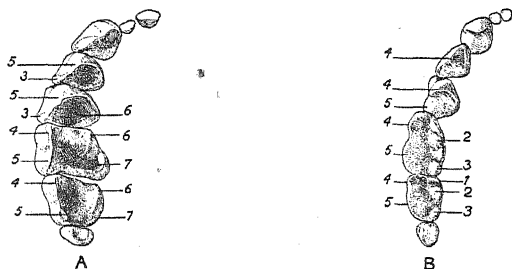
A. Right upper, B. Left lower tooth-row.  $\times \frac{1}{4}$ .

For explanation of lettering of cusps see text, p. 205.

the lower canine extends, on the inner side, upwards to (or almost to) the middle of the tooth, often terminating in a small cusp-like projection (text-fig. 47); in *Artibeus* the cingulum terminates at about the level of the cutting-edges of the lower incisors,

without forming a cusp-like projection (text-fig. 48).—(3) Cusp 4 (anterior cusp) of  $p^1$  more developed than in *Artibeus*, as a rule forming a small, but distinct, pointed cusp in the unworn tooth; in *Artibeus* cusp 4 of  $p^1$  is practically completely wanting.—(4)  $m^3$  is small, but not nearly reduced to the same degree as in *Artibeus*, situated direct behind  $m^2$ , and almost (or quite) as broad

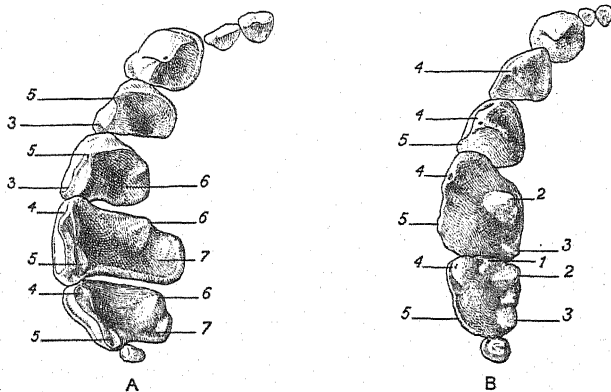
Text-fig. 45.



*Enchisthenes harti*, ♂ imm. Trinidad. Type, B.M. 92.9.7.8.

A. Right upper, B. Left lower tooth-row.  $\times \frac{1}{4}$ .

Text-fig. 46.



*Artibeus planirostris fallax*, ♀ ad. Kanuku Mts., British Guiana.  
B.M. 1.6.4.60.

A. Right upper, B. Left lower tooth-row.  $\times \frac{1}{4}$ .

For explanation of lettering of cusps see text, p. 205.

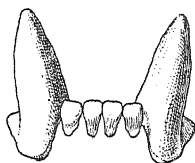
as the hinder margin of  $m^2$  (text-fig. 44 A); of the elements of  $m^3$ , cusps 4 and 6 are clearly observable, cusps 5 and 7 only present as mere rudiments; in cross section  $m^3$  is about six times the size of a lower incisor, or  $\frac{1}{3}$  of  $m^2$ ; in *Artibeus*  $m^3$ , when present, is

quite rudimentary (equal to a lower incisor, or about  $\frac{1}{10}$  of  $m^2$ ), its elements cannot be discriminated, and the tooth has been pushed postero-internally to  $m^2$  (text-fig. 46 A); but in most species of *Artibeus*  $m^3$  is entirely wanting.—(5) As a consequence of the larger size and posterior position of  $m^3$  in *Uroderma*, cusp 5 of  $m^2$  is considerably more labial in position (text-fig. 44 A); in *Artibeus* the cusp has moved so far towards the lingual side as to occupy, precisely or very nearly, the middle of the posterior margin of the tooth (text-fig. 46 A).—(6) Cusp 2 of  $m_1$  is in *Uroderma* represented by a low subacutely pointed tubercle near

Text-fig. 47.



Text-fig. 48.

Text-fig. 47.—*Uroderma thomasi*, ♂ ad. Bellavista, Bolivia. Type, B.M. 1.2.1.37.Front view of lower incisors and canines.  $\times \frac{1}{4}$ .Text-fig. 48.—*Artibeus jamaicensis lituratus*, ♀ ad. Villa Rica, Paraguay.

U.S. N. M. 105587.

Front view of lower incisors and canines.  $\times \frac{1}{4}$ .

the front end of the tooth and close to the lingual side of cusp 4 (text-fig. 44 B); in *Artibeus* cusp 2 is very strongly developed, rising as a high slender cone near the middle of the lingual margin of  $m_1$  (text-fig. 46 B).—(7) In accordance with the less reduced size of  $m^3$ , also  $m_3$  in *Uroderma* is proportionately larger, equal to  $\frac{1}{3}$ – $\frac{1}{4}$  of  $m_3$  (text-fig. 44 B); in *Artibeus*  $m_3$  is  $\frac{1}{8}$ – $\frac{1}{12}$  the size of  $m_3$ , or, in more than half the number of species, entirely wanting.

*External characters.*—The lateral margin of the horseshoe, at level with nostrils, is turned upwards so as to form a conspicuous fold; when pressed downward to the muzzle this fold takes the shape of a small, rounded lobe, slightly projecting beyond the rest of the lateral margin. In several species of *Artibeus* (*A. planirostris*, *jamaicensis*, etc.) there is a similar, though rather less pronounced folding of the lateral margin of the horseshoe. The difference between *Uroderma* and *Artibeus* in this respect is, therefore, only one of degree.

The wing-structure is very similar to that of *Artibeus*; the fifth metacarpal averages a trifle shorter than the third, whereas in all species of *Artibeus* it is generally a trifle longer than the third. How closely in all other respects the wing-structure of *Uroderma* resembles that of *Artibeus* may be seen by reference to the wing-indices on p. 310 (compare, for instance, the indices of *Uroderma* with those of *A. rosenbergi*).

*Uroderma* has a narrow line of whitish fur down the middle of the upper side, sometimes ill-defined, but never quite obliterated; *Artibeus* has no trace of a dorsal line.

*Species.*—Two, *U. bilobatum* and *thomasi*.

*Range.*—From São Paulo and Bolivia to Costa Rica; unrepresented in the West Indies (Trinidad excepted).

*Remarks.*—*Uroderma* was proposed by Peters (*l. s. c.*) as a generic name for those known species of "*Artibeus*" which have  $\frac{2}{3}$  molars, viz., at Peters's time, *A. bilobatus*, *fallax*, and *concolor*. The name, in this sense, was adopted by Dobson (*l. s. c.*), though only as the designation of a "subgenus" of *Artibeus*, and he recognised two species only, *A. bilobatus* and *planirostris*, the latter including Peters's *fallax* as a "synonym" and *concolor* as a "variety." The number of species would now be five: *bilobatus*, *thomasi*, *concolor*, *planirostris*, *hirsutus*.—In 1901, Rehn (*l. s. c.*) proposed to restrict the name *Uroderma* to *A. bilobatus*, on account of its elongate skull, noticeably higher rostrum, and "two rounded lobes" on the lateral margins of the horseshoe.

Any subdivision of the genus "*Artibeus*," in its old sense, according to the number of molars ( $\frac{2}{3}$ ,  $\frac{3}{3}$ , or  $\frac{2}{2}$ ) is artificial. The natural subdivisions are these two: *A. bilobatus* and *thomasi* on one side (*Uroderma*), all other species on the other (*Artibeus*). There is a wide gap between *Uroderma* and *Artibeus*, in this sense, whereas all species referred to *Artibeus* in the present paper, irrespective of the presence or absence of the rudimentary  $m^3$  and  $m_3$ , are extremely closely inter-related. *Uroderma* differs both in the shape of the skull and in several important dental characters, and it is in these respects not approximated by any species of *Artibeus*. As to the dental characters pointed out above (pp. 214–216), nos. 1 (bilobate outer upper incisors), 4 (position of  $m^3$ ), 5 (position of cusp 5 of  $m^3$ ), and 6 (no cusp 2 in  $m_1$ ) constitute absolute differences between *Uroderma* and *Artibeus*, though a slight restriction is perhaps advisable with regard to no. 1, in so far as in some species of *Artibeus* the outer upper incisor can show, rarely and as a perfectly individual aberration, a faint leaning towards a bifid shape; as to nos. 2 (cingulum of lower canines), 3 (cusp 4 of  $p^4$ ), and 7 (size of  $m_3$ ), the difference is one of degree only. In having a narrow line of white fur down the middle of the upper side, *Uroderma* is similar to the majority of species of *Vampyrops* and allied genera, but different from all species of *Artibeus*.

#### URODERMA BILOBATUM Pet.

1842. *Phyllostoma species inedita* Rüppell, Verzeichniss der in dem Museum der Senckenbergischen naturforschenden Gesellschaft aufgestellten Sammlungen, i. p. 11, no. II. D. 3 a.—Brazil?
1865. *Phyllostoma personatum* (not Wagner) Peters, MB. Akad. Berlin, pp. 587–88, footnote.
1866. *Uroderma bilobatum* Peters, MB. Akad. Berlin, p. 394.—São Paulo; Cayenne.
1878. *Artibeus bilobatus* Pet., Dobson, Cat. Chir. Brit. Mus. pp. 518–19.
1880. *Artibeus (Uroderma) bilobatus* Pet., Thomas, P. Z. S. p. 396.—Sarayacu, Ecuador.

1889. *Artibeus bilobatus* Pet., Cope, Amer. Naturalist, xxiii. no. 26, pp. 130-31 (Febr. 1889).—"Chapada" [probably Chapadas da S. Maria, N. Minas Geraes].
1897. *Artibeus bilobatus* Pet., J. A. Allen & Chapman, Bull. Am. Mus. N. H. ix. Art. ii. p. 15 (26 Febr. 1897).—Trinidad, W. I.
1900. *Uroderma bilobatum* Pet., J. A. Allen, Bull. Am. Mus. N. H. xiii. Art. viii. p. 89 (12 May, 1900).—Santa Marta region, Colombia.
1901. *Artibeus bilobatus* Pet., Thomas, Ann. & Mag. N. H. (7) viii. p. 191 (Sept. 1901).—Para.
1902. *Uroderma concolorum* Lyon, Proc. Biol. Soc. Wash. xv. pp. 83-84 (25 April, 1902).—Colon, Panama.
1904. *Uroderma bilobatum* Pet., J. A. Allen, Bull. Am. Mus. N. H. xx. Art. xxxv. p. 458 (28 Nov. 1904).—Ciudad Bolivar, Venezuela.
1906. *Uroderma bilobatum* Pet., Peters, Chir. Mus. Zool. Berol. pl. xi. a (issued Jan. 1906).

*Diagnosis*.—Skull small, tooth-rows short, ears small.

*U. bilobatum* and *thomasi*.—The difference between these two species will be pointed out below, p. 221.

*Hairing on limbs and interfemoral*.—Forearm densely haired for the proximal two thirds of its upper surface. A tuft of short hairs on the metacarpal of the pollex. Upper side of tibia and foot distinctly haired. Interfemoral very short-haired, its hinder margin almost naked.

*Colour*.—General impression brown, varying in shade; four facial stripes, a dorsal stripe. There are two colour extremes, a dark brown and a light brown, but the contrast between them is by no means great.

Dark-coloured examples (many skins, all of fully adult individuals, teeth unworn or slightly worn; localities: Colombia (Cali; Santa Marta), islands off Panama, Chiriqui):—Upper side dark brown, darker than Ridgway's Prout's brown; base of hairs on hinder back approaching drab, on the neck lighter, varying from light drab to wood-brown or ecru-drab. Under side a dark shade of drab. Supraorbital and infraorbital stripes broad, whitish. A narrow whitish longitudinal stripe from the occiput to the interfemoral; front half of the stripe sometimes very indistinct or quite obliterated. A more or less distinct narrow whitish margin to the ears.

Three examples (Chanchamayo, Peru, and Brava I., W. of Panama; adults, with unworn or very slightly worn teeth) are noticeably darker: upper side sooty brown, under side dark smoky grey.

Lighter-coloured examples (two skins: Egas, Amazonas, and Valencia, Venezuela; adults, with unworn teeth):—Upper side Prout's brown (one skin) or mars-brown washed with russet (the other), base of hairs wood-brown; under side light drab. Facial stripes, dorsal line, and ear-edgings as usual.

*Individuals from different localities*.—Specimens have been examined from localities dotted over practically the whole area from Para, Amazonas, and Peru in the south, to Costa Rica in the north. I am unable to see any differences, in the skull, teeth, or external characters, between individuals from all these localities. The subjoined table of measurements (p. 219), in which the specimens have been arranged according to their geographical habitat, shows that also the dimensions are the same.

*Measurements of Uroderma bilobatum.*

	Pará.	Amazonas.	Peru.	Ecuador.	S. Colombia.	S. Marta, Colombia. Valencia, Venezuela.	Colon.	Islands off Panama.	Chiriqui.	Costa Rica.
	1 adult, 1 skull.	1 adult, 1 skull.	2 adults, 2 skulls.	1 adult, 1 skull.	1 adult, 1 skull.	3 adults, 3 skulls.	2 yr. adults, 2 skulls.	9 adults, 8 skulls.	2 adults, 2 skulls.	1 adult, 1 skull.
	MIN. MAX.	MIN. MAX.	MIN. MAX.	MIN. MAX.	MIN. MAX.	MIN. MAX.	MIN. MAX.	MIN. MAX.	MIN. MAX.	MIN. MAX.
Skull, total length, to front of c	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
" mastoid width	23-2	23-3	23-3	.....	.....	22	22-7	.....	.....	23
" width of brain-case	11-2	.....	11-3	.....	.....	.....	11	11-2	.....	.....
" zygomatic width	9-8	.....	10	10	10	.....	10	9-7	9-8	9-3
" maxillary width, across m <sup>1</sup>	12-8	.....	13	13	9-3	9	8-8	13	13	.....
" across cingula of canines.	9-2	8-9	9-2	9-2	6	5-8	5-7	9	9-8	.....
Mandible, to front of inc.	5-8	5-5	.....	5-8	.....	15-2	15	5-7	5-8	.....
Upper teeth, c-m <sup>3</sup>	15-8	15-6	16-2	16	15-7	15-8	15-2	15	15-8	15-8
Lower teeth, c-m <sup>3</sup>	8-2	8	8-2	8-2	8	8-2	8-2	7-8	8-2	8-2
Ear-conch, length, inner margin	8-8	8-8	8-8	9	8-8	8-7	9	8-5	9	8-8
" length, outer margin	11-5	.....	.....	.....	.....	.....	11	11-2	.....	.....
" width	16-8	.....	.....	.....	.....	.....	11	11-5	.....	.....
Tragus, length	12	.....	.....	.....	.....	.....	5-8	.....	.....	.....
Lancelet, length	5-8	.....	.....	.....	.....	.....	8-3	.....	.....	.....
" width	5	.....	.....	.....	.....	.....	4-8	.....	.....	.....
Horseshoe, width	7-5	.....	.....	.....	.....	.....	6-2	.....	.....	.....
Forearm	44-7	43	42-2	41	.....	40	42	43-2	43-2	43-2
3rd metacarpal	42-2	40	41-2	12	.....	40	41	41-2	41-2	39
1st	14-8	15-5	16	15	38	37-8	39	38-2	41-7	14-7
2nd	23-7	21-5	22-5	22-2	14-5	14-7	14-5	14	15-2	14-7
3rd	11-3	11-8	11-8	11-8	21	21	21-8	21-2	23-2	21-5
4th metacarpal	40-3	38-7	41	39	36-8	37	38	37-5	40	38-7
1st	13	12-2	13-2	12-2	12-2	11-8	12-5	13	12-5	12-2
2nd	15	14-5	14-8	12-8	14	12-8	13-2	13-8	13-7	14-8
3rd	41	40	41	39	37-5	38-5	37	39	41	38-7
4th metacarpal	9-8	10-2	10-2	9-7	9-7	9-2	10-2	10-2	9-2	9-5
1st	12-8	12	13	12	.....	11	11-8	11-8	11-8	13
2nd	15	16-7	16-8	15-8	.....	15	15-7	15-8	16-2	16-5
3rd	11-2	.....	.....	11-5	.....	10-7	10-2	11	11-5	12
4th	5-5	.....	.....	.....	.....	5	4-7	.....	.....	.....



*Specimens examined*.—24 specimens (19 skins) and 23 skulls, from the following localities:—

British Museum:—Brazil: Para (1); Egas (Teffé), Amazonas (1).—Peru: Chanchamayo, 1200 and 1500 m. (2).—Ecuador: Sarayacu (1).—Colombia: Cali, 1100 m. (1); Onaca, Santa Marta, 700 m. (2).—Venezuela: Valencia (1).—Panama: Colon (1); Chiriqui (2); islands off Panama: Brava I. (3); Cebago I. (1); Jicarón I. (1); Insoleta (1); Gobernador I. (3).—Costa Rica: Miravalles, 400–500 m. (1).—21 skulls, from all the localities enumerated.

U.S. National Museum\*:—Trinidad: Port of Spain (1).—Panama: Colon (1).—Skulls of both specimens.

*Range*.—From São Paulo and Peru, at least as far north as Costa Rica; unrepresented in the West Indies (Trinidad excepted).

Peters's *Uroderma bilobatum*, 1866.—The type, in the Berlin Museum, is "ein jüngeres Exemplar aus St. Paulo in Brasilien"; Peters had also "zwei andere ausgewachsene [Exemplare] aus Cayenne" in the Berlin Museum, and "ein männliches ausgewachsenes Exemplar in Weingeist" from the Frankfurt Museum without exact locality (*cf.* Rüppell, *l. s. c.*). The whole of the original description and all measurements (there is an obvious error in the measurement of the second phalanx of the fourth digit) precisely agree with the series of specimens here referred to *U. bilobatum*.—The figures in the plate belonging to Peters's intended Monograph of Bats (*l. s. c.*) are excellently drawn and partly well reproduced, but the hind legs in the life-size figure (fig. 1) are much too short, as if drawn from a damaged specimen (with broken legs?).

Lyon's *Uroderma convexum*, 1902.—Type: ♀ young ad.; Colon, Panama. Based on two specimens from the type locality. For comparison Lyon had two *U. bilobatum* from Chapada, Brazil (probably São João River, Chapada da S. Maria, N. Minas Geraes; and probably the same specimens as recorded by Cope, 1889, *l. s. c.*, and by Rehn, 1901, *l. s. c.*).—The characters of *U. convexum* are summed up, by Lyon, as follows: "Similar to *U. bilobatum* Peters, but with tooth-rows distinctly arcuate" ("less nearly parallel than those of *U. bilobatum*").

Besides a specimen from Colon in the British Museum (presented by Marquis Doria), nine specimens from islands W. of Panama, two from Chiriqui, and one from Costa Rica, I have had for examination Lyon's paratype, a young adult from Colon.—"*U. convexum*" is in every respect indistinguishable from *U. bilobatum* from Brazil, Peru, Ecuador, Colombia, Venezuela, and Trinidad. In the whole series of skulls of *U. bilobatum* examined, 23 in number, the upper tooth-rows are decidedly arcuate; by close comparison of the skulls an excessively small variation in the outline of the tooth-rows is, of course, observable, as is also the

\* U.S. N. M. nos. 22472 (37901), 111721.

case in any sufficiently large series of skulls of any species of *Artibeus*, *Vampyrops*, &c.; but these minute variations are entirely independent of differences in the geographical habitat of the individuals. The straightest tooth-row I have seen is in a skull from Colon (the type locality of *U. convexum*) and in one from Chiriqui; the most arcuate in one from Peru, one from Para, and one from Chiriqui; the others are, of course, intermediate.

#### URODERMA THOMASI K. And.

1906. *Uroderma thomasi* Knud Andersen, Ann. & Mag. N. H. (7) xviii. p. 419 (1 Dec. 1906).—Bellavista, Bolivia.

*Diagnosis*.—Similar to *U. bilobatum*, but with noticeably larger skull, longer tooth-rows, and larger ears and nose-leaves.

*U. thomasi* and *bilobatum*.—*U. thomasi* differs from *U. bilobatum* in the following particulars:—

The skull is precisely of the same shape as in *U. bilobatum*, but in every respect larger; the *largest* skull (out of 23) of *U. bilobatum* measures in total length 23.3 mm., the *smallest* skull of two *U. thomasi* 24.7 mm.; all other dimensions of the skull are correspondingly increased.—In the whole series of *U. bilobatum* examined the length of the maxillary tooth-row varies between 7.8 and 8.5 mm. (average 8.1 mm.), in *U. thomasi* it measures 8.9–9 mm. The ears are not only absolutely, but proportionately larger. The lancet longer and, especially, broader.—For further details see the table, below p. 223.

*U. thomasi* is, probably, the Bolivian representative of *U. bilobatum*; but in all the points referred to above there seems to be a perfectly clear line of separation between the two forms; the gap between them is not overbridged by any specimen I have seen.

The distribution of the fur on the limbs and interfemoral is as in *U. bilobatum*. The colour of the pelage as in the ordinary dark brown "phase" of that species; the whitish ear-edgings are very distinct.

*Specimens examined*.—Two, with skulls, viz., ♂ ad., Bellavista, Bolivia, 1400 m., about 15° S., 68° W. (type specimen); and ♂ ad., Reyes, Bolivia, about 13° S., 67° W. (presented by Marquis Doria). Both specimens in the collection of the British Museum.

*Range*.—As yet known from N. Bolivia only.

#### ENCHISTHENES K. And.

1906. *Enchisthenes* Knud Andersen, Ann. & Mag. N. H. (7) xviii. p. 419 (1 Dec. 1906).—Type: *Artibeus harti* Thos.

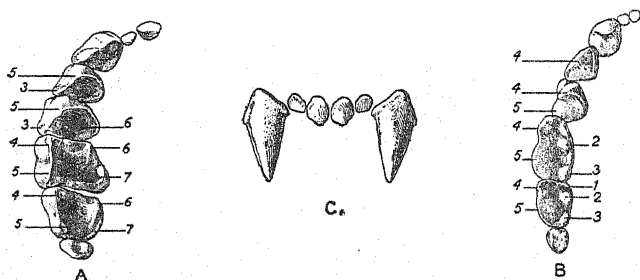
*Diagnosis*.—Allied to *Artibeus*, but median upper incisors simple;  $m^3$  in row, as broad as the hinder margin of  $m^2$ ;  $m_3$  comparatively large, equal to about  $\frac{1}{4}$  of  $m_2$ ; tragus with a pointed projection on the inner margin, near the tip.

*Enchisthenes*, *Artibeus*, and *Uroderma*.—*Enchisthenes* is much more closely allied to *Artibeus* than to *Uroderma*. In all the characters which separate *Uroderma* from *Artibeus*, *Enchisthenes* agrees with the latter genus, the following points excepted: the position and relative size of  $m^3$  and the relative size of  $m_3$  are as in *Uroderma*; as a consequence of the former fact, also the position of cusp 5 of  $m^2$  is as in *Uroderma*. *Enchisthenes* differs from *Artibeus* chiefly in the particulars referred to above, in the diagnosis of the genus.

*Principal characters*.—The skull has all the characters of an *Artibeus* skull: short and broad, not long and subcylindrical as in *Uroderma*; profile, from front of sagittal crest to nasals, much concave, as in *Artibeus*, not very slightly concave or almost straight, as in *Uroderma*; palate short, as in *Artibeus*, not long as in *Uroderma*; plane of anterior nasal openings very oblique, as in *Artibeus*, not looking chiefly forward, as in *Uroderma*.

*Cutting-edges of median upper incisors simple*, pointed in the centre, without any indication of a median notch (text-fig. 49 c); in this respect *Enchisthenes* differs both from *Artibeus* (median upper incisors bifid) and *Uroderma* (all upper incisors bifid). Outer upper incisors somewhat narrower and much shorter than median

Text-fig. 49.



*Enchisthenes harti*, ♂ imm. Trinidad. Type, B.M. 92.9.7.8.

A. Right upper, B. Left lower tooth-row; C. Front view of upper incisors and canines.  $\times \frac{1}{4}$ .

incisors; cutting-edge simple.  $p^3$  and  $p^4$  as in *Artibeus* and *Uroderma*. Cusp 7 of  $m^1$  well developed, but rather small, more recalling the corresponding cusp in *Uroderma* than that of *Artibeus*. Position of cusp 5 of  $m^2$  as in *Uroderma*, not at (or very nearly at) the middle of the hinder margin of the tooth, as in *Artibeus*; cusp 7 of  $m^2$  so excessively small as to be scarcely observable without a lens, forming only a very low postero-internal margin to the tooth.  $m^3$  situated direct behind  $m^2$ , in position and shape quite as in *Uroderma*, not rudimentary and situated postero-internally to  $m^2$ , as in *Artibeus* (compare text-fig. 45A with text-figs. 44A and 46A on pp. 214 and 215). Cingulum on inner side of lower canines

(next to  $i_2$ ) low, terminating at level with cutting-edges of incisors, as in *Artibeus*. Cusp 4 of  $p^4$  practically completely wanting, as in *Artibeus*. Cusp 2 of  $m_1$  very much as in *Artibeus* (perhaps a trifle more anterior in position); the cusp is situated so close to the lingual cingulum as to appear, on cursory inspection, in direct connection with this latter; in reality the cingulum passes the lingual side of the cusp, as in *Artibeus*; between cusps 2 and 3 the cingulum has developed two very small supplementary tubercles. Cusp 1 of  $m_2$  (antero-internally, direct in front of cusp 2) small, but quite distinct.  $m_3$  of the same relative size as in *Uroderma*, viz. equal to about  $\frac{1}{2}$  the bulk of  $m_2$ .

A very conspicuous, pointed, upwardly directed projection on the inner margin of the tragus, about 1 mm. below the tip. Neither

*Measurements of Uroderma bilobatum and thomasi, and  
Enchisthenes harti.*

	<i>U. bilobatum.</i>			<i>U. thomasi.</i>		<i>E. harti.</i>
	23 adults, 22 skulls.			2 adults, 2 skulls.		Type, ♂ yg. ad.
	MIN.	MAX.	MED.	MIN.	MAX.	
Skull, total length, to front of c ...	mm. 22	mm. 23.3	mm. 22.8	mm. 24.7	mm. 24.8	mm. 20.8
" mastoid width .....	11	11.3	11.2	12	12.2	11
" width of brain-case .....	9.7	10	9.9	10.6	10.8	9.7
" zygomatic width .....	12.8	13.7	13	14	14.2	12.5
" maxillary width, across $m^1$ .....	8.8	9.8	9.2	10	10	8.3
" across cingula of canines .....	5.5	6.2	5.9	6.1	6.2	5.8
Mandible, to front of inc. ....	15	16.2	15.6	16.8	16.8	14.2
Upper teeth, c- $m^3$ .....	7.8	8.5	8.1	8.9	9	7.2
Lower teeth, c- $m_3$ .....	8.5	9	8.9	9.5	9.7	8
Ear-conch, length, inner margin ...	11	11.5		12.3	13	
" length, outer margin ...	15.7	16.8		18	18.5	
" width .....	11	12		12.8	13.7	
Tragus, length .....	5.8	5.8		7	7	
Lancet, length .....	8.3	9.2		10	10	6
" width .....	4.8	5		6.2	6.5	5
Horseshoe, width .....	6.2	7.5		7.8	8	6.2
Forearm .....	40	45	43	44	45	38
Pollex .....	11	12.2	11.6	12	12.2	10.2
3rd metacarpal .....	37.8	42.5	40.3	42	42	34.5
III <sup>1</sup> .....	14	16	14.9	14.8	16.5	13
III <sup>2</sup> .....	21	23.8	22.3	23.2	23.5	17.2
III <sup>3</sup> .....	10.5	12.7	11.7	13.2	14	12
4th metacarpal .....	36.8	41.2	39.1	40.5	41.7	33.2
IV <sup>1</sup> .....	11.8	13.2	12.7	12.8	13.5	11.7
IV <sup>2</sup> .....	12.8	15	13.7	14.2	14.8	10.8
5th metacarpal .....	37	41.8	39.9	41.7	42	33.8
V <sup>1</sup> .....	9.2	10.8	10	9.7	11	9.2
V <sup>2</sup> .....	11	13	12.1	12.2	12.8	9.2
Interfemoral .....	13.5	15		14.2	17.8	
Lower leg .....	15	17.8	16.4	17	18	13
Foot, with claws .....	10.2	12.2	11.3	11.8	12.2	10
Calcar .....	4.7	6	5.3	5.8	6.8	5.2

in *Artibeus* nor in *Uroderma* is there any trace of a similar projection.

The material is unsuitable for a description of the wing-structure, the only specimen known being a young adult. It would seem, however, that the wing-indices do not differ very essentially from those of *Artibeus*; the second phalanx of the third digit is, apparently, relatively rather short, less than  $1\frac{1}{2}$  the length of the first phalanx.

*Species*.—The type of the genus is the only species known.

*Range*.—Trinidad.

#### ENCHISTHENES HARTI THOS.

892. *Artibeus harti* Thomas, Ann. & Mag. N. H. (6) x. pp. 409-10 (Nov. 1892).

*Diagnosis*.—Upper tooth-row 8 mm.; forearm 38 mm.

*Nose-leaves*.—Horseshoe in front completely fastened down to and continuous with the integument of the muzzle; lateral part turned up into a slight fold, somewhat recalling the fold in a *Uroderma* horseshoe, but not forming a small rounded lobe. *Lancet* unusually short and broad, the width at base being almost equal to  $\frac{5}{6}$  its length from nostrils to tip.

*Interfemoral*.—Extremely short, only about 3-4 mm. in the middle line.

*Fur on limbs and interfemoral*.—Upper side of proximal two thirds of forearm, the whole of the interfemoral, and upper side of tibia and foot, densely haired. A tuft of very short hairs on the metacarpal of the pollex.

*Colour* (of an immature specimen, preserved in alcohol).—The colour of the fur would seem to be much as in the light phase of *Artibeus toltecus rarus* (below p. 300). Details as to the facial stripes and ear-margins cannot be given from the only specimen available, which is not in a perfect state of preservation.

*Measurements*.—On p. 223.

*Specimens examined*.—One, the type, a young adult male, in the collection of the British Museum.

*Range*.—As yet only one record, from the island of Trinidad, W.I.

#### ARTIBEUS Leach.

1821. *Artibeus* Leach, Trans. Linn. Soc. London, xiii. pt. i. pp. 74-75.—Type: *Artibeus jamaicensis* Leach.

1821. *Madateus* Leach, op. cit. pp. 74, 81-82.—Type: *Madateus lewisii* Leach (= *Artibeus jamaicensis* Leach).

1827. *Medateus* Gray, Griffith's Animal Kingdom, v. p. 74.—Misspelling of *Madateus*.

1835. *Arctibeus* Gray, Mag. Zool. & Bot. ii. pp. 486-87.—Misspelling of *Artibeus*.

1856. *Pteroderma* Gervais, Expéd. Castelnau, Mamm., livr. 15, p. 34, pls. viii. fig. 7, x. fig. 1.—Type: "*Pteroderma perspicillatum* L." (= *Artibeus jamaicensis* Leach).

1856. *Artibeus* Gervais, op. cit. pp. 34-35, pl. ix. fig. 2.—Misspelling for *Artibeus*.

1856. *Dermanura* Gervais, op. cit. p. 36, pls. viii. fig. 4, ix. figs. 4, 4a, xi. fig. 3.—Type: *Dermanura cinereum* Gervais.

1892. *Artobius* Winge, E Museo Lundii, ii. pt. i. p. 3 (cf. p. 38).—Nomen emendatum.

*Artibeus* and *Uroderma*.—*Artibeus* differs from *Uroderma* in the following particulars:—

Skull short and broad. Rostrum conspicuously depressed; profile of skull, from front of sagittal crest to nasals, therefore much concave (text-fig. 43, on p. 213); height of rostrum at  $p^4$  much less than width of skull at "postorbital" constriction (immediately behind postorbital processes or their rudiments). Bony palate shorter: distance from palation to front of incisors always less (generally very much less) than zygomatic width (text-fig. 43, on p. 213). Median backwardly extending portion of bony palate (behind last molar) shorter, not equal to the combined length (externally) of  $m^1$  and  $m^2$ , often equal only to the length of  $m^1$ . Plane of anterior nasal opening more oblique than in *Uroderma*.

Inner upper incisors bifid, outer upper incisors simple. The cingulum of the lower canine terminates, on the inner side, about the level of the cutting-edges of the lower incisors, without forming a cusp-like projection (text-fig. 48, on p. 216). Cusp 4 (anterior cusp) of  $p^4$  practically completely wanting (for this and the following dental characters see text-fig. 41, on p. 208).  $m^3$  either quite rudimentary or, in most species, completely wanting; when present the tooth is situated postero-internally to  $m^2$ . As a consequence of the small size and postero-internal position of  $m^3$ , cusp 5 of  $m^2$  is decidedly more lingual in position, occupying, precisely or very nearly, the middle of the posterior margin of the tooth. Cusp 2 of  $m_1$  very strongly developed, rising as a high slender cone near the middle of the lingual margin of the tooth. In accordance with the rudimentary condition, or complete disappearance, of  $m^3$ , also  $m_3$  is relatively smaller than in *Uroderma*, or, in certain species, entirely wanting.

No species of *Artibeus* has a narrow line of whitish fur down the middle of the upper side.

*Artibeus* and *Enchisthenes*.—*Artibeus* differs from *Enchisthenes* chiefly in the following respects:—

Cutting-edges of inner upper incisors bifid, not simple, pointed in the centre, without any trace of a median notch, as in *Enchisthenes*.  $m^3$  rudimentary, situated postero-internally to  $m^2$  or, most often, entirely wanting, not relatively large and situated direct behind  $m^2$ , as in *Enchisthenes*.  $m_3$  very small, equal to  $\frac{1}{8}$ – $\frac{1}{12}$  of  $m^2$  or entirely wanting; in *Enchisthenes* equal to about  $\frac{1}{4}$  of  $m^2$ .—In no species of *Artibeus* is there any trace of a pointed projection on the inner margin of the tragus.

*On the principal characters subject to specific variation.*—(A) Skull.—In the fourteen species referred to the genus *Artibeus* in the present paper, three types of skull can be discriminated:—(1) The ordinary shape of the skulls, characteristic of all species but three, is that figured on p. 213 (text-fig. 43): rostrum moderately depressed, profile of nasals, from base to tip, very nearly horizontal (not slightly ascending), palate not shortened.—(2) In one species, *A. concolor*, the facial portion of the skull is

peculiarly shortened (see p. 233).—(3) In two species, *A. turpis* and *nanus*, the depression and flattening of the rostrum and heightening of the brain-case reach a climax, the rostrum being even very slightly bent upwards (profile of nasals rather a little ascending than horizontal), the palate shortened (see text-fig. 57, on p. 307).

(B) Teeth.—The species fall into two sections, probably forming two natural branches of the genus: those in which cusp 7 of  $m^1$  is comparatively small, viz. *A. glaucus*, *watsoni*, *cinereus*, and *rosenbergi* (text-figs. 53, 54, 55); and those in which the cusp is comparatively large, viz. *A. concolor*, *planirostris*, *hirsutus*, *jamaicensis*, *toltecus*, *quadrivittatus*, *phacotis*, *aztecus*, *turpis*, and *nanus*; in their extremes (upper extreme of the former and lower extreme of the latter section) these two sections come very near to each other.—The rudimentary upper posterior and lower posterior molar ( $m^3$  and  $m_3$ ) can completely disappear; consequently the number of molars varies between  $\frac{3}{2}$  (*A. concolor*, *planirostris*, *hirsutus*),  $\frac{3}{2}$  (*A. jamaicensis*, *glaucus*, *watsoni*), and  $\frac{2}{2}$  (*A. cinereus*, *rosenbergi*, *toltecus*, *quadrivittatus*, *phacotis*, *aztecus*, *turpis*, *nanus*).

(C) Tragus.—Inner margin thickened, outer margin sharp; cross-section, therefore, triangular. A notch in the outer margin, at level with base of inner margin; below this notch a square-shaped lobe, the upper and lower corners of which are produced into sharp points (this lobe is, in the following pages, called “the basal lobe”); above the notch a sharply projecting point (in the following pages, “the median projection”); outer margin, above the median projection, as a rule serrate; inner margin of tragus perfectly simple from base to tip. In so far the tragus of *Artibeus* does not differ appreciably from that of *Uroderma*.—The number of serrations on the upper half of the outer margin, above the median projection, is practically the same in all species but one, varying between 0 and 5; the variations within these limits is not specific, but individual; the usual number is 4, 3, or 2; sometimes the serrations are sharp, very often rounded, often reduced to very small nodules, this latter leading, in extreme cases, to complete obliteration of some, or all, of the serrations. In *A. concolor* I have found the number of serrations to be 7–8, but only one specimen has been available for examination.

(D) Nose-leaves.—In all species but two the front margin of the horseshoe is free; in *A. planirostris* it is sometimes, in *A. jamaicensis* often fastened down to, or even perfectly continuous with, the integument of the muzzle. In no species is the lancet so short as in *Enchisthenes harti*.

(E) Wing-structure.—Broadly speaking the wing-structure is the same in all species: fifth metacarpal averaging a trifle longer than third, fourth slightly the longest; second phalanx of third digit a little less than, or equal to, or a little more than  $1\frac{1}{2}$  the length of the first phalanx.—The specific variation chiefly affects the proportionate length of the first phalanx of the third, fourth,

and fifth digits; in *A. fallax*, *hirsutus*, and *jamaicensis* (and *concolor*?) the first phalanx is proportionately shorter, its indices being: third digit 281-298, fourth digit 245-260, fifth digit 186-201; in all other species the phalanx is proportionately longer, its indices being: third digit 327-357, fourth digit 279-304, fifth digit 217-240.

(F) Hairing on limbs and interfemoral.—In most species the posterior part of the interfemoral and the upper side of the tibia are very thinly haired or, at least on cursory inspection, almost naked; in a few species, especially *A. hirsutus*, *toltecus*, and *aztecus*, they are densely furred.

(G) Colour.—The specific variation in colour is extremely small, the individual variation considerable. As a means to separate the species of this genus colour-characters must, therefore, be used with great caution.—The general colour pattern is this: upper side some shade of brown, under side lighter; very often four facial stripes; often narrow whitish margins to the ears; sometimes white tips to the wings. Young (not full-grown) individuals darker and duller than adults.—In most, if not all, species there is a darker and a lighter colour extreme, as a rule (perhaps always) connected by several intermediate stages; the light-coloured extreme sometimes occurs in full-grown specimens with quite unworn teeth, *i.e.* in specimens which have evidently just reached the mature age, but I have never seen it in decidedly immature (not full-grown) individuals. A pair of white or whitish supraorbital and infraorbital stripes are very often present, but they vary, sometimes even in the same species (*A. jamaicensis*, and others), through all stages from complete absence to very strong development; as a rule (not always) they are strongest in lighter-coloured individuals. White tips to the wings are most conspicuous in the larger species (*A. planirostris*, *hirsutus*, *jamaicensis*), more indistinct or, as a rule, practically wanting in the smaller species.

(H) Size.—No less than ten species (*A. glaucus*, *watsoni*, *cinereus*, *rosenbergi*, *toltecus*, *quadrivittatus*, *phaeotis*, *aztecus*, *turpis*, *nanus*) are, externally, approximately of equal size, the forearm varying between 36.5 and 47 mm. Three species (*A. planirostris*, *hirsutus*, *jamaicensis*) are noticeably, or much, larger: forearm 53.5-76 mm. One (*A. concolor*) is intermediate: forearm about 50 mm.

(I) Conclusions.—The principal, and in most cases the only reliable, differences between the species are cranial and dental. No specimen of *Artibeus* ought to be identified without a careful examination of the skull and teeth.

*Species*.—In 1878, Dobson catalogued 5 forms of *Artibeus*, viz. *A. planirostris*, *A. planirostris* var. *concolor*, *A. perspicillatus*, *A. cinereus*, *A. quadrivittatus*. The total number of forms recognised in the present paper is 25 (14 species). The following table gives, in chronological order, a view of all the forms named, their type localities, their identification in Dobson's Catalogue, and their identification in this paper:—



Year.	Name.	Type locality.	Dobson's Catalogue.	This paper.
1821.	<i>A. jamaicensis</i> Leach.	Jamaica.	<i>A. perspicillatus</i> .	<i>A. jamaicensis jamaicensis</i> .
1821.	<i>Mastomys leucotis</i> Leach.	Jamaica.	<i>A. perspicillatus</i> .	<i>A. jamaicensis jamaicensis</i> .
1823.	<i>Phyllotoma lituratus</i> Licht.	Brazil.	Omitted.	<i>A. jamaicensis lituratus</i> .
1823.	<i>Phyllotoma plantirostre</i> Spix.	Bahia.	<i>A. plantirostris</i> .	<i>A. plantirostris plantirostris</i> .
1826.	<i>Phyllotoma superciliarum</i> Wied.	Rio de Janeiro.	<i>A. perspicillatus</i> .	? <i>A. jamaicensis lituratus</i> .
1826.	<i>Phyllotoma obscurum</i> Wied.	Rio de Janeiro.	? <i>A. plantirostris</i> .	? <i>A. plantirostris plantirostris</i> .
1831.	<i>A. carpolepis</i> Gosse.	Jamaica.	<i>A. perspicillatus</i> .	<i>A. jamaicensis jamaicensis</i> .
1835.	<i>Dermanura cinerea</i> Gerv.	Brazil.	<i>A. cinereus</i> .	<i>A. cinereus cinereus</i> .
1836.	<i>Stenoderma toltecum</i> Sauss.	Mexico.	<i>A. plantirostris</i> .	<i>A. toltecus toltecus</i> .
1839.	<i>A. fallax</i> Pet.	Guiana.	<i>A. plantirostris</i> .	<i>A. plantirostris fallax</i> .
1865.	<i>A. concolor</i> Pet.	Surinam.	<i>A. quadrivittatus</i> .	<i>A. concolor</i> .
1865.	<i>A. quadrivittatus</i> Pet.	Surinam.	<i>A. quadrivittatus</i> .	<i>A. quadrivittatus</i> .
1878.	<i>A. macdougalli</i> Dobbs. (ex Gray MS.).	Cuba.	<i>A. jamaicensis parvipes</i> .	<i>A. jamaicensis parvipes</i> .
1878.	<i>A. grandis</i> Dobbs. (ex Gray MS.).	St. Andrew & I.	<i>A. perspicillatus</i> .	<i>A. jamaicensis lituratus</i> .
1880.	<i>Dermanura eva</i> Cope.	Unknown.	<i>A. perspicillatus</i> .	<i>A. jamaicensis jamaicensis</i> .
1880.	<i>A. coryi</i> All.	Cuba.	<i>A. perspicillatus</i> .	<i>A. jamaicensis jamaicensis</i> .
1893.	<i>A. glaucus</i> Thos.	Chanchamayo, Peru.	<i>A. quadrivittatus</i> .	<i>A. glaucus</i> .
1897.	<i>A. palmarum</i> All. & Chapm.	Trinidad.	<i>A. quadrivittatus</i> .	<i>A. jamaicensis palmarum</i> .
1897.	<i>A. intermedius</i> All.	S. José, Costa Rica.	<i>A. quadrivittatus</i> .	<i>A. jamaicensis palmarum</i> .
1897.	<i>A. rosenbergi</i> Thos.	Cuchavi, N. Ecuador.	<i>A. quadrivittatus</i> .	<i>A. rosenbergi</i> .
1899.	<i>A. flavovittatus</i> Bangs.	S. Marta, Colombia.	<i>A. quadrivittatus</i> .	<i>A. jamaicensis palmarum</i> .
1901.	<i>A. watsoni</i> Thos.	Chiriqui.	<i>A. quadrivittatus</i> .	<i>A. watsoni</i> .
1902.	<i>Dermanura rara</i> Miller.	S. Javier, N. Ecuador.	<i>A. quadrivittatus</i> .	<i>A. toltecus rarus</i> .
1902.	<i>Dermanura phaeotis</i> Miller.	Yucatan.	<i>A. quadrivittatus</i> .	<i>A. phaeotis</i> .
1902.	<i>A. hercules</i> Rehn.	E. Peru.	<i>A. quadrivittatus</i> .	? <i>A. plantirostris fallax</i> .
1904.	<i>A. parvipes</i> Rehn.	Cuba.	<i>A. quadrivittatus</i> .	<i>A. jamaicensis parvipes</i> .
1904.	<i>A. rufus</i> All.	Yungas, Bolivia.	<i>A. quadrivittatus</i> .	<i>A. jamaicensis lituratus</i> .
1904.	<i>A. insularis</i> All.	St. Kitts, W. I.	<i>A. quadrivittatus</i> .	<i>A. jamaicensis jamaicensis</i> .
1906.	<i>A. guatemalensis</i> Ell.	Chichen Itza, Yucatan.	<i>A. quadrivittatus</i> .	<i>A. jamaicensis guatemalensis</i> .
1906.	<i>Dermanura guatemalensis</i> Ell.	Vera Cruz.	<i>A. quadrivittatus</i> .	<i>A. phaeotis</i> .
1906.	<i>A. plantirostris ornatus</i> K. A.	Trinidad, W. I.	<i>A. quadrivittatus</i> .	<i>A. plantirostris plantirostris</i> .
1906.	<i>A. plantirostris grenadensis</i> K. A.	Grenada, W. I.	<i>A. quadrivittatus</i> .	<i>A. plantirostris grenadensis</i> .
1906.	<i>A. hirsutus</i> K. A.	Michoacan, Mex.	<i>A. quadrivittatus</i> .	<i>A. hirsutus</i> .
1906.	<i>A. jamaicensis equatorialis</i> K. A.	Zaruma, S. Ecuador.	<i>A. quadrivittatus</i> .	<i>A. jamaicensis equatorialis</i> .
1906.	<i>A. jamaicensis princeps</i> K. A.	Guadalupe, W. I.	<i>A. quadrivittatus</i> .	<i>A. jamaicensis princeps</i> .
1906.	<i>A. cinereus bogotensis</i> K. A.	Bogota, Colombia.	<i>A. quadrivittatus</i> .	<i>A. cinereus bogotensis</i> .
1906.	<i>A. aztecus</i> K. A.	Morelos, Mex.	<i>A. quadrivittatus</i> .	<i>A. aztecus</i> .
1906.	<i>A. turpis</i> K. A.	Tabasco, Mex.	<i>A. quadrivittatus</i> .	<i>A. turpis</i> .
1906.	<i>A. nanus</i> K. A.	Guerrero, Mex.	<i>A. quadrivittatus</i> .	<i>A. nanus</i> .
1907.	<i>Uroderma validum</i> Ell.	Cayenne.	<i>A. quadrivittatus</i> .	<i>A. plantirostris fallax</i> .

*Range*.—From S. Brazil, Paraguay, and Bolivia, to Sinaloa in North Central Mexico, including the whole of the West Indies.

*Geographical review of the species and subspecies*.—The subjoined geographical review is based almost exclusively on the material examined by myself. An asterisk before a technical name indicates that the type-locality of the species or subspecies falls within the region under consideration.

Paraguay.—*A. jamaicensis lituratus*.

Brazil.—*A. concolor* (Para, Upper Amazonas).—\**A. planirostris planirostris* (Bahia, Matto Grosso, Pernambuco, Maranhão, Para).—*A. planirostris fallax* (Para).—\**A. jamaicensis lituratus* (Sta. Catharina, Parana, Minas Geraes, Bahia, Para).—\**A. cinereus cinereus* (Para).—*A. quadrivittatus* (Pernambuco).

Peru.—*A. planirostris* (? *fallax*).—\**A. glaucus*.

Ecuador.—\**A. jamaicensis equatorialis*.—*A. jamaicensis lituratus*.—\**A. rosenbergi*.—\**A. toltecus rucus*.

Guiana.—\**A. concolor*.—\**A. planirostris fallax*.—*A. cinereus cinereus*.—\**A. quadrivittatus*.

Venezuela.—*A. planirostris planirostris*.—*A. planirostris fallax* (Lower Orinoco).—*A. jamaicensis palmarum*.—*A. cinereus cinereus*.—*A. cinereus bogotensis* (N.W. Venezuela).—*A. rosenbergi*.

Trinidad.—\**A. planirostris trinitatis*.—\**A. jamaicensis palmarum*.—*A. cinereus cinereus*.

Tobago.—*A. planirostris trinitatis*.—[*A. jamaicensis palmarum*.]

Grenada.—\**A. planirostris grenadensis*.—[*A. jamaicensis palmarum*.]

St. Vincent.—*A. jamaicensis palmarum*.

Dominica, Guadeloupe.—\**A. jamaicensis preceps*.

Colombia (excluding Panama).—*A. jamaicensis equatorialis* (Cali).—*A. jamaicensis lituratus*.—\**A. cinereus bogotensis*.

Central America (including Panama).—*A. planirostris planirostris* (whole region).—*A. jamaicensis jamaicensis* (whole region).—*A. jamaicensis palmarum* (whole region).—\**A. watsoni* (Panama, Nicaragua).—*A. toltecus toltecus* (Costa Rica, Nicaragua, Guatemala).

Belize and Yucatan.—\**A. jamaicensis yucatanicus*.—\**A. phaeotis*.

Mexico (excluding Yucatan).—*A. planirostris planirostris* (Chiapas, Guerrero).—\**A. hirsutus* (Michoacan, Colima, Jalisco).—*A. jamaicensis jamaicensis* (Campeche, Chiapas, Tehuantepec, Oaxaca, Morelos, Vera Cruz).—*A. jamaicensis palmarum* (Oaxaca, Vera Cruz, Jalisco).—\**A. toltecus toltecus* (Oaxaca, Vera Cruz, Jalisco, Durango).—*A. phaeotis* (Vera Cruz).—\**A. aztecus* (Morelos).—\**A. turpis* (Tabasco).—\**A. nanus* (Guerrero, Vera Cruz, Colima, Sinaloa).

Cuba (perhaps including Key West).—\**A. jamaicensis parvipes*.

St. Andrews, Old Providence, Jamaica, San Domingo, Porto Rico, St. Martins, St. Kitts.—\**A. jamaicensis*.

*Proposed subdivisions of the genus*.—Gervais (1856, l. s. c.) was

the first to make an attempt to subdivide *Artibeus* into three genera characterised by their number of molars, as follows:—

(1) *Artibeus*, molars  $\frac{3}{3}$ ; species three, viz. "*A. jamaicensis*," according to the figure of the teeth clearly not *A. jamaicensis* Leach, but *A. planirostris* Spix; the localities given by Gervais, "de la Jamaïque, de la Guadeloupe et de Cuba" are undoubtedly wrong; further, "*A. lineatus*" (= *Vampyrops lineatus*), and "*A. undatus*" (= *Stenoderma rufum*);

(2) *Pteroderma*, molars  $\frac{2}{2}$ ; species one, "*Pt. perspicillatum*," "répandue au Pérou, au Brésil, et à la Guayane"; this is, as shown by the figures of the teeth, *A. jamaicensis* Leach (sensu lato);

(3) *Dermanura*, molars  $\frac{2}{2}$ ; species one, "*D. cinerea*," i. e. *A. cinereus* of the present paper.

In July 1865\*, Peters divided *Artibeus* into two "groups" (subgenera), viz.:—

(1) *Artibeus* Leach, molars  $\frac{3}{3}$  or  $\frac{2}{2}$ ; species four: "*A. perspicillatus* Geoff." (i. e. *A. jamaicensis lituratus* of this paper), "*A. jamaicensis* Leach" (i. e. *A. jamaicensis jamaicensis*), *A. fallax* (i. e. *A. planirostris fallax*), and *A. concolor*;

(2) *Dermanura* Gervais, molars  $\frac{2}{2}$ ; species three: *D. cinerea*, ? *D. tolteca*, and *D. quadrivittata*.

Peters placed the species with  $\frac{3}{3}$  and  $\frac{2}{2}$  molars together in one group, "weil dieser kleine Zahnstumpf allein kein Grund sein kann, Arten, die sonst im Schädel- und Zahnbau, so wie in jeder anderen Beziehung ganz mit einander übereinstimmen, generisch von einander zu trennen." But he was not quite consistent; if "dieser kleine Zahnstumpf" ( $m^3$ ) is not sufficient reason to separate, as different groups, species with  $\frac{3}{3}$  and  $\frac{2}{2}$  molars, it is difficult to see why the other, equally rudimentary tooth ( $m_3$ ) furnishes a valid reason to separate, as a distinct section, the species with  $\frac{2}{2}$  molars from those with  $\frac{3}{3}$  molars. From Peters's standpoint there would seem to be two alternatives only, either not to subdivide the genus, acknowledging that the presence or absence of a perfectly rudimentary tooth is a character of specific, but not of subgeneric or generic importance, or to subdivide it into three groups.—Peters himself has probably felt the inconsistency of his classification. At all events, in spite of his own argument, that the species with  $\frac{3}{3}$  and  $\frac{2}{2}$  molars "sonst im Schädel- und Zahnbau, so wie in jeder anderen Beziehung ganz mit einander übereinstimmen," he, only a few months later †, proposed a new subgeneric name, *Uroderma*, for the species with  $\frac{3}{3}$  molars. And, finally, in June 1866 ‡, he evidently regarded the sections no more as subgenera, but as genera.—Thus Peters had now, in 1866, practically adopted Gervais's view, that *Artibeus* is to be divided into three genera, according to the number of molars, viz.:—

(1) *Uroderma* Peters 1865 (synonym: *Artibeus* Gervais 1856,

\* Peters, MB. Akad. Berlin, 13 July 1865, p. 356, footnote.

† Peters, MB. Akad. Berlin, 13 Nov. 1865, p. 588, footnote.

‡ Peters, MB. Akad. Berlin, 25 June 1866, p. 394.

not *Artibeus* Leach 1821), molars  $\frac{3}{3}$ ; species *U. bilobatum* Pet., "*U. fallax* Pet.," and *U. concolor*;

(2) *Artibeus* Leach 1821 (synonym: *Pteroderma* Gervais 1856), molars  $\frac{2}{3}$ ; species "*A. perspicillatus* Geoff." and "*A. jamaicensis* Leach";

(3) *Dermanura* Gervais 1856, molars  $\frac{2}{2}$ ; species as above.

By this arrangement Peters, as already said, had practically gone back to Gervais's standpoint; these words are true also in the sense that his arrangement is in no respect an improvement upon the older one; both of them are typical examples of artificial classification. Gervais selected as the *only* leading character for his subdivisions the presence or absence of a vanishing tooth; Peters did precisely the same. Gervais proved the fallacy of the taxonomic character selected by him, in so far as he placed together in one "genus" (*Artibeus*) a true *Artibeus*, a *Vampyrops*, and a *Stenoderma*, because they, though different in many important respects, happen to have  $\frac{3}{3}$  molars; and, on the other hand, separated into two genera (*Artibeus* and *Pteroderma*) two species so closely related as to be sometimes extremely difficult to distinguish (*A. planirostris* and *jamaicensis*). Peters proved the same, by putting together in one "genus" (*Uroderma*) two generically widely different forms (*U. bilobatum* and "*A. fallax*"), because they both happen to have  $\frac{3}{3}$  molars, at the same time separating into two "sections" or genera "*A. fallax*" and *A. jamaicensis*, which differ in next to nothing but the presence or absence of a rudimentary tooth.

In the description of the genus *Uroderma* (above, p. 217) I have given my reasons for keeping *U. bilobatum* and *thomasi* generically separate from *Artibeus*. The next question, therefore, is, if, having removed these two species from *Artibeus*, it might be convenient to divide it into three subgenera or genera, according to the number of molars. Also in this modified shape I am unable to accept Peters's proposal, for the following reasons:—

(1) The series of species here referred to the genus *Artibeus* form one natural group the members of which are perfectly similar in all essential cranial, dental, and external characters.

(2) *A. planirostris* has  $\frac{3}{3}$  molars; but of 73 skulls examined of this species, two lack  $m^3$  on one side, two on both sides, and one of these latter also lacks  $m_3$  on one side. *A. hirsutus* has  $\frac{3}{3}$  molars; but of 8 skulls, two lack  $m^3$  on one side. *A. jamaicensis* has  $\frac{2}{3}$  molars; but of 182 skulls, two lack  $m_3$  on one side, four on both sides. *A. rosenbergi* has  $\frac{2}{2}$  molars, but of the only two individuals known, the one has an  $m_3$  on one side. *A. toltecus* has  $\frac{2}{2}$  molars, but of 26 skulls, one has an  $m_3$  on one side.—None of the individuals here referred to are aberrant on account of very young or very high age. Some of them, it will be noticed, have lost the rudimentary molar\* ( $m^3$  or  $m_3$ ) which is normally present in

\* It is hardly necessary to say that in all the aberrant individuals referred to above  $m^3$  or  $m_3$  (or both) are *entirely* lost, i. e. no trace of their alveoli has been left.

individuals of their species; others, in which the absence of  $m_3$  is normal, show, individually, a tendency to reversion to the more primitive stage in which this small tooth was present.—A character which is not only in itself very insignificant, but not even individually perfectly constant is evidently unsuitable for the separation of groups of generic or subgeneric rank.

(3) By subdividing *Artibeus* according to the number of molars, the "genera" or "subgenera" would be these three:—molars  $\frac{3}{3}$ , *A. concolor*, *planirostris*, *hirsutus*; molars  $\frac{2}{3}$ , *A. jamaicensis*, *glaucus*, *watsoni*; molars  $\frac{2}{2}$ , *A. cinereus*, *rosenbergi*, *toltecus*, *quadrivittatus*, *phaeotis*, *aztecus*, *turpis*, *nanus*.—But *A. planirostris* is much more closely related to *A. jamaicensis*, which is placed in a different genus or subgenus, than to *A. concolor*, with which it is associated in one group. *A. glaucus* and *watsoni* are put together with *A. jamaicensis*, solely because they like this latter have a rudimentary  $m_3$ , but in all other respects they are much more closely related to *A. cinereus*, which has permanently lost  $m_3$ . The eight species with  $\frac{2}{2}$  molars constitute a strangely heterogeneous section; *A. cinereus* is nearer to *A. glaucus* and *watsoni* than to any of the forms with  $\frac{2}{3}$  molars with which it is put together; *A. rosenbergi* is unique in the genus in the strong reduction of  $m^2$ ; *A. toltecus*, *quadrivittatus*, and *aztecus* are, probably, rather more closely allied to *A. jamaicensis* than to any species with  $\frac{2}{2}$  molars; and, finally, *A. turpis* and *nanus* form a small natural group characterised by the unusually strongly depressed and slightly upwardly directed cranial rostrum.—From this it will be evident that a subdivision of the genus based on the presence or absence of  $m^2$  or  $m_3$  would give only a very distorted view of the mutual affinities of the species.

(4) A study of the species of *Artibeus* has led the writer of this paper to the conclusion that they, probably, fall into two natural groups, which have nothing to do with the hitherto proposed subdivisions of the genus, viz., those species in which cusp 7 of  $m^1$  is relatively small (*A. glaucus*, *watsoni*, *cinereus*, and *rosenbergi*), and those in which it is relatively large (all the other species). This point, which has more theoretical than practical interest, will be discussed in the last section of the present paper, pp. 314–316.

#### ARTIBEUS CONCOLOR Pet.

1865. *Artibeus concolor* Peters, MB. Akad. Berlin, p. 357.—Paramaribo (Surinam).  
 1878. *Artibeus planirostris* (not Spix), var. *a*, Dobson, Cat. Chir. Brit. Mus. p. 518.—Upper Amazons.  
 1892. *Artibeus concolor* Pet., Thomas, Ann. & Mag. N. H. (6) x. pp. 409–410, footnote (Nov. 1892).—Some cranial measurements of the type.  
 1901. *Artibeus concolor* Pet., Thomas, Ann. & Mag. N. H. (7) viii. p. 191 (Sept. 1901).—Para.

*Diagnosis*.—An *Artibeus* with  $\frac{3}{3}$  molars, the maxillary tooth-row measuring about 7·2, the forearm about 50 mm.

*Teeth*.—The teeth of *A. concolor* are proportionately very much smaller than in the two other species with  $\frac{3}{3}$  molars, *A. plani-*

*rostris* and *hirsutus*. *A. concolor* is externally not very inferior in size to a small *A. hirsutus* or *A. planirostris trinitatis*; the forearm in the only specimen examined of *A. concolor* measures 50 mm., in the smallest *A. hirsutus* 53.7 mm.; but the length of the maxillary tooth-row is in *concolor* only 7.2 mm., in the smallest-toothed *A. hirsutus* 9.5 mm. A comparison with *A. planirostris* shows a similar contrast.—In structure the teeth of *A. concolor* do not differ from those of *A. planirostris* and *hirsutus*.

*Skull*.—Rostrum (probably owing to small size of teeth) relatively much shorter than in *A. hirsutus* or *planirostris*. The ratio between the length of the rostrum (from front of sagittal crest to front of alveolus of a median incisor) and the length of the brain-case (from front of sagittal crest to median posterior point of lambdoid crest) is in *concolor* 68:100, in *hirsutus* and *planirostris* 83:100; or, expressed in another way, the length of the nasal region, from front of sagittal crest to front of nasal bones, is in *A. concolor* equal to the least interorbital width of the skull, in *hirsutus* and *planirostris* equal to  $1\frac{1}{2}$  this width. The rostrum in *A. concolor* is a trifle less depressed than in *hirsutus* and *planirostris*, but the difference in this respect is inconspicuous.—The short rostrum makes, of course, the total length of the skull much smaller: in *concolor* 22.4, in the shortest-skulled *hirsutus* available 26.8 mm., although, as mentioned above, the animal in external dimensions is only a trifle larger than *concolor*. The difference in the length of the forearm, between *concolor* and a small *hirsutus*, is only 3.7 mm., but in the length of the skull 4.4 mm.—In every other respect the skull of *concolor* is similar to that of *planirostris* and *hirsutus*.

*Nose-leaves*.—Front margin of horseshoe free; both front and lateral margins quite plain (not crenulate). It remains to be ascertained if these characters are perfectly constant (compare the individual variation in *A. planirostris*, *hirsutus*, and *jamaicensis*).

*Tragus*.—7 or 8 sharp, but short, serrations on the upper half of the outer margin, above the median projection; the highest number of serrations found in any other species of *Artibeus* is 5. A large series of *A. concolor* will, no doubt, show some variation both in the number and shape of the serrations.

*Hairing on limbs and interfemoral*.—Essentially as in *A. planirostris*: upper side of proximal half of forearm, upper side of interfemoral (the extreme posterior margin excepted) and of femur (the distal part excepted) densely haired.

*Colour*.—Upper side from shoulders backward yellowish brown (rather browner than Ridgway's "wood-brown"); base of hairs almost ecru-drab. In front of the shoulder region the darker hair-tips are short or altogether wanting, exposing the white or yellowish-white ground-colour of the fur. Under side light greyish drab. Supraorbital stripes distinct, infraorbital stripes almost obsolete. There seems to be no light margins to the ears.

Tips of wings (region of third phalanx of third digit) lighter-coloured.

The above description is taken from an adult female with unworn teeth, preserved in alcohol. There can scarcely be any doubt that the specimen represents a "light phase"; the type in the Berlin Museum is, judging from Peters's short description, considerably darker. Similar contrasts in the coloration of the fur occur in many other species of *Artibeus*.

*Measurements*.—On p. 246.

*Specimens examined*.—♀ ad. (alc.), Para; with skull; British Museum.—I have been unable to find the specimen (♀ ad., Upper Amazons) catalogued by Dobson (*l. s. c.*) as *A. planirostris* var. *a*.

*Range*.—Surinam; Para; Upper Amazons (probably).

Peters's *A. concolor*, 1865.—Type locality: Paramaribo, Surinam. *A. concolor* was described by Peters as being in every respect similar to *A. fallax* [i. e. *A. planirostris fallax* of the present paper], but much smaller; molars  $\frac{3}{2}$ ,  $m^3$  in position and relative size as in *A. fallax*; "Unterarm" 47 mm. (Peters probably measured the radius, not the "forearm"), tibia 18 mm. There are no measurements of the skull in the original description, but according to Prof. Matschie (in a letter quoted by Oldfield Thomas in 1892, *l. s. c.*) the maxillary tooth-row measures 7.5 mm., the maxillary width across  $m^1$ – $m^1$  9.9 or 10 mm.—These details seem to exclude all doubt as to the identification of *A. concolor*.

From the above description of *A. concolor* it will be evident that Dobson was mistaken in regarding this species as a mere variety of *A. planirostris*; it is far more different from *A. planirostris* than is this latter from *A. jamaicensis* ("*A. perspicillatus*" in Dobson's Catalogue).

*A. concolor* seems to be very rare in collections, the type in the Berlin Museum, two specimens in the British Museum, and one in the Para Museum being, to my knowledge, the only examples on record.

#### ARTIBEUS PLANIROSTRIS Spix.

*Diagnosis*.—Molars  $\frac{3}{2}$ . Maxillary tooth-row 9.8–12 mm. Forearm 55–73 mm. Tibia and distal part of interfemoral so short-haired as to appear almost naked. Colour of fur of upper side not drab.

*Teeth*.—The teeth of this species have been described in detail and figured above, pp. 207–212, text-fig. 41.

The rudimentary  $m^3$ , situated postero-internally to  $m^2$ , partly pressed into a sharp angular emargination in the posterior margin of this latter, between its cusps 5 and 7, is very rarely wanting in adult individuals. 67 skulls of fully adult individuals have been examined, representing all the races of *A. planirostris* recognised in this paper; in two skulls (*A. p. fallax*, ♂ ad. and ♀ ad., British Guiana, teeth unworn and slightly worn, B.M. nos. 6.4.8.7 and 8) is  $m^3$  present on one side, while the tooth

and its alveolus are wanting on the other side; in two skulls (*A. p. fallax*, ♀ ad., British Guiana, teeth almost unworn, B.M. no. 6.4.8.11; and *A. p. planirostris*, ♀ ad., Bahia, teeth unworn, U.S. N. M. no. 102457) is  $m^1$  entirely wanting on both sides, and in one of these latter skulls (102457) also  $m_2$  is entirely lost on one side. Thus, only 3 per. cent. of the large series of skulls of adults examined have entirely lost  $m^1$  on both sides.

It is of some importance to emphasise that the disappearance of  $m^3$  in *A. planirostris* is a very rare individual aberration, inasmuch as the presence of this small tooth is in many cases the only character by which *A. planirostris* can be safely discriminated from *A. jamaicensis*.

*Tragus*.—In most individuals there are 4 or 5 small serrations on the outer margin of the tragus, above the median projection; the serrations may be sharp, but as a rule they are more or less rounded off, often reduced to inconspicuous nodules, sometimes almost obliterated. The variation is quite individual.

*Nose-leaves*.—According to Dobson, the anterior margin of the horseshoe in *A. planirostris* is "free, separated from the muzzle, straight, unnotched," and the author of the British Museum Catalogue of Chiroptera lays much stress on this character as a difference between *A. planirostris* and *A. jamaicensis* ("*A. perspicillatus*"). In a majority of individuals of *A. planirostris* the front margin of the horseshoe is distinctly "free," but there is every intermediate stage from this condition, through a margin clearly "bound down," though still more or less projecting, to a margin so completely fastened down as to be almost continuous with the integument of the muzzle. As a similar (or, if anything, still greater) variation in this respect occurs in *A. jamaicensis*, the character is quite useless for a discrimination of these two species. —The margin of the horseshoe is sometimes simple, sometimes crenulate in front, sometimes crenulate all round; the crenulation occasionally extends to the margins of the lancet.—The lateral margins of the horseshoe are not rarely bent up so as to form a fold, suggesting the condition characteristic of *Uroderma*.

*Hairing on limbs and interfemoral*.—The proximal half or two-thirds of the forearm, the metacarpal of the pollex, the upper side of the femur (the tip, as a rule, excepted), and the base of the interfemoral next to the body and the femur, are densely haired. The tip of the femur and the whole of the tibia covered with so short and sparse hairs as to appear almost naked. The toes, from the tarsus to the base of the claws, clothed with rather long, coarse hairs.

*Colour*.—Young individuals:—Upper side from shoulders backward dark and dull smoky brown, this colour confined to the distal third or fourth of the hairs; base of hairs slate. On the anterior part of the upper side, from the shoulders forward, the hair-bases are distinctly lighter, almost smoke-grey. Under side dark smoke-grey, with a peculiar mottled appearance, due to the very short, almost greyish-white tips to the hairs. Tips of wings



(region of third phalanx of third digit) more or less whitish. A pair of whitish or greyish-white supraorbital stripes, as a rule indistinct, sometimes altogether wanting.—This is the usual colour in young, not full-grown individuals; it never occurs in the mature *A. planirostris*.

At a somewhat later stage, the colour of the hinder back is less smoky, more approaching dark brown in tinge, with the hair-bases almost drab. The rest of the upper side, from the shoulders forward, much of the same general colour, but the dark hair-tips shorter, the hair-bases considerably lighter, varying from wood-brown to greyish white; very often the hair-tips in this region of the upper side are so short as to more or less (or almost completely) expose the light ground-colour, in which case there, consequently, is a contrast between the anterior and posterior part of the upper side. The under side essentially as in immature individuals, though as a rule a shade lighter. Supraorbital stripes often completely wanting, often rather indistinct, rarely strongly developed; there is sometimes, though rarely, an indication of infraorbital stripes.—This is the commonest colour in the adult *A. planirostris*, very often occurring also in specimens with much worn teeth.

A considerably lighter colour is acquired by some adult individuals:—Upper side approaching Prout's brown, base of hairs almost ecru-drab. Anterior portion of upper side, from shoulders forward, as a rule noticeably lighter, owing to the dark hair-tips being shorter and the wood-brown hair-bases showing through. Under side almost drab, with short greyish-white tips to the hairs. Supraorbital stripes as a rule well marked, often strongly developed, wood-brown or whitish; there is often a more or less definite indication of infraorbital stripes.—This stage evidently represents the "light phase" so common in many bats: I never saw a young *A. planirostris* in this colour-stage; it is apparently confined to the fully adult age, and it is only acquired by a limited number of individuals.

Thus there are three stages of colour: a dark and dull smoky brown, a dark brown, and a Prout's brown; the two former come very near to each other, the third, when fully developed, is different at a glance. The first is confined to the immature age; the second is characteristic of a majority of adults; the third seems to occur only in some fully adult and aged individuals; it is especially common in the largest race, *A. p. fallax*, but not rare in *A. p. planirostris* and *trinitatis*.

*Range*.—From Central Brazil (Bahia, Matto Grosso) and S. Bolivia (Caiza) to S. Mexico (Chiapas, Guerrero), including the Venezuelan coast islands (Trinidad, Tobago) and the southern Windward Islands (Grenada), but excluding the rest of the West Indies.

*Remarks*.—By the combination of the five characters given in the brief diagnosis above, p. 234, *A. planirostris* (all races) is readily distinguishable from all other species of the genus. The

first character (molars  $\frac{3}{3}$ ) excludes all species, except *A. concolor* and *hirsutus*; the addition of the second and third characters (large skull and teeth, large external dimensions) excludes *A. concolor*; the addition of the fourth and fifth (tibia and distal inter-femoral almost naked, general colour of fur of upper side not drab) exclude also *A. hirsutus*.

*Forms*.—Four races of *A. planirostris* are described below: *A. p. planirostris*, *trinitatis*, *grenadensis*, and *fallax*. The three former come very near to each other, the fourth is rather more completely differentiated, but cannot be specifically separated.

#### ARTIBEUS PLANIROSTRIS PLANIROSTRIS Spix.

1823. *Phyllostoma planirostre* Spix, Simiarum et Vespertilionum Brasiliensium species novæ, p. 66, pl. xxxvi. fig. 1.—Bahia.  
 1826. ? *Phyllostoma obscurum* Wied. Beitr. Naturg. Bras. ii. pp. 203–205.—Rio de Janeiro.  
 1840. *Phyllostoma perspicillatum* (partim, nec L.) Wagner, Schreber's Säugethiere, Suppl. i. pp. 403–405.—Re-description of Spix's type of *Ph. planirostre*.  
 1865. *Phyllostoma planirostre* Spix, Peters, MB. Akad. Berlin, p. 587.—Spix's type of *Ph. planirostre* re-examined.  
 1878. *Artibeus planirostris* Spix (partim), Dobson, Cat. Chir. Brit. Mus. pp. 515–517.  
 1901. *Artibeus planirostris* Spix, Robinson & Lyon, Proc. U.S. Nat. Mus. xxiv. p. 148.—La Guaira, Venezuela (specimens examined).  
 1904. *Artibeus intermedius* All. (errore), J. A. Allen, Bull. Am. Mus. N. H. xx. Art. iv. p. 79 (29 Febr. 1904); cf. Allen, t. c. Art. xx. p. 233 (29 June 1904).—Chiriqui.  
 1904. *Artibeus planirostris* Spix, Thomas, P. Z. S. 1903, ii. p. 234 (1 April 1904).—Chapada, Matto Grosso (specimen examined).

*Diagnosis*.—Total length of skull 27·5–30 mm. (average 28·5 mm.); zygomatic width 16·8–18·5 mm. (average 17·6 mm.); forearm 57·8–65·2 mm. (average 61·8 mm.).

*A. p. planirostris* and *trinitatis*.—*A. p. planirostris* can only be discriminated from its nearest relative, *A. p. trinitatis*, by average characters. In *A. p. planirostris* the forearm and metacarpals average about 4 mm., the tibia 1·5 mm. longer; the ears are, generally, a little larger; the average difference in the size of the skull and teeth is very small.—For further details see the table, p. 246.

*Specimens from different localities*.—In the subjoined comparative table of measurements (p. 240) I have divided the material examined into three groups, viz. specimens from Brazil, Venezuela, and S. Mexico. The table shows that the size of the skull and teeth and the external dimensions are identical in individuals from these three regions.

*Specimens examined*.—26 specimens (12 skins) and 20 skulls, from the following localities:—

British Museum:—Brazil: Chapada, Matto Grosso, 700–900 m. (1); Pernambuco (2); S. Lourenço, Pernambuco, 28–60 m. (8); Igarapé, Assi, Para, 50 m. (2); “Brazil” (1).—10 skulls, from all the localities enumerated.

U.S. National Museum\*:—Brazil: Bahia (1); Anilo, Maranhão

\* U.S. N. M. nos. 100201, 100203, 102457, 102894–96, 104565, 104567–69, 104574, 126554.

(5).—Venezuela: Macuto, La Guaira (3).—S. Mexico: Palenque, Chiapas (2); Papayo, Guerrero (1).—10 skulls, representing all these localities.

*Range*.—From Central Brazil (Bahia, Matto Grosso) to S. Mexico (Chiapas, Guerrero). As yet no record from Guiana (see *A. p. fallax*).

Spix's *Phyllostoma planirostre*, 1823.—Type locality: "in suburbiis Bahiæ." From Spix's description and figure so much only can be decided with certainty that his *Ph. planirostre* is a large species of *Artibeus*. There being only two large species known, the point to be settled is this: is Spix's type the form called *A. planirostris* in the present paper ( $\frac{3}{3}$  molars), or is it *A. jamaicensis* ( $\frac{2}{3}$  molars). Both of these species occur in the Bahia region.—Three authors, Wagner in 1840, Peters in 1865, and Dobson in 1878, have discussed this question and arrived at different conclusions:—

Wagner's description of "*Phyllostoma perspicillatum*" (1840, *l. s. c.*) was based on what he considered Spix's types of *Ph. planirostre*:—"Von seinem *Phyllostoma planirostre* hat Spix 3 Exemplare in Weingeist hinterlassen," he writes; and "die nachstehende Beschreibung ist nach den Spix'schen Exemplaren entworfen." The only additional information of importance contained in Wagner's description is this: "Backenzähne finden sich  $\frac{4}{5}$  vor," i. e. Wagner found only  $\frac{2}{3}$  molars in the presumed types.—From this it might be inferred that Spix's *Ph. planirostre* is Leach's *A. jamaicensis*.

Peters writes (1865, *l. s. c.*): "Nach Untersuchung des einzigen Originalexemplars in Weingeist [von *Ph. planirostre*] kann ich nur die Uebereinstimmung desselben mit *Ph. perspicillatum* Geoffroy bestätigen," and found the specimen which he considered the type to have  $\frac{2}{3}$  molars.—From this, again, it would seem that *Ph. planirostre* Spix (1823) is a synonym of *A. jamaicensis* Leach (1821), this latter being the only large species of the genus with  $\frac{2}{3}$  molars. There is, it will be noticed, a discrepancy between Wagner and Peters with regard to the number of typical specimens; according to Wagner there are three, according to Peters one only.

Dobson (1878, *l. s. c.*), though he had no opportunity of examining the type (or types) of *Ph. planirostre*, rejected Peters's identification on account of the following words, in Spix's original description: "vexillum nasale . . . inferius lateraliter et antice libere pendens"; he regarded this statement of Spix, that the horseshoe is "free" in front, as decisive evidence that *Ph. planirostre* is the large species with  $\frac{3}{3}$  molars, not the large species with  $\frac{2}{3}$  molars; and the difficulty that, according to Peters, the type of *planirostre* has  $\frac{2}{3}$  molars only, he overcame by arguing that the type might be immature, or very old, or in this respect abnormal.—But the fact is, it must be said at once, that the condition of the front margin of the horseshoe is thoroughly unreliable

as a differential character between the two large species of *Artibeus* (see pp. 235 and 253 of this paper), so that Dobson's way of settling the question was exceedingly unsafe. That, nevertheless, the conclusion was right is proved by the following information kindly forwarded to me by Dr. W. Leisewitz, Munich (in litt., 15 Sept. 1906):—

The register of the Munich Museum ("Zoologische Sammlung des Bayerischen Staates") for 1830 has this entry: "No. 65, *Phyllostoma planirostrum* (Sp.), 1 Exemplar"; the specimen is labelled "Bahia, Spix coll."; this settles the question as to the number of typical specimens; there is one only. When Wagner mentioned three typical examples, the reason was, I am informed by Dr. Leisewitz, probably that Spix brought back from Bahia not only one *Ph. planirostre* but also two "*Ph. perspicillatum*" (i. e. *A. jamaicensis lituratus* of the present paper), both of which latter are also in the Munich Museum; Wagner evidently considered all three examples to be one species (*A. planirostris* and *jamaicensis* are difficult to discriminate externally), and his statement that "*planirostre*" has  $\frac{2}{3}$  molars is undoubtedly taken from one of the two *A. jamaicensis*, not from the true type of *Ph. planirostre*.—This latter has, Dr. Leisewitz writes, a distinct  $m^2$  on both sides of the upper jaw; the anterior margin of the horseshoe is (as said by Spix) free; the forearm measures 58.5, third metacarpal 57, first phalanx of third digit 17.7, second phalanx of third digit 28.5 mm. This settles, beyond all doubt, the identification of Spix's type: it is *Ph. planirostris planirostris* of this paper, not *A. jamaicensis lituratus* (molars  $\frac{2}{3}$ , forearm 64–76 mm.), the only other large form of *Artibeus* known from Bahia.—There remains Peters's wrong statement about the number of molars of the "type" ( $\frac{3}{2}$  according to Peters, not  $\frac{2}{3}$  as in fact is the case): On Oct. 17, 1865, Siebold sent Spix's Chiroptera to Peters for inspection, among these the type of *Ph. planirostre* and one example of "*A. perspicillatus* L." (*A. jamaicensis lituratus* Licht.); in the list accompanying the specimens, Siebold unfortunately entered these two bats as "2 *Phyll. planirostre*, Bahia." When, therefore, Peters wrote that Spix's type of *Ph. planirostre* has  $\frac{2}{3}$  molars only, he no doubt examined the wrong specimen (*A. j. lituratus*), not the true type; this explanation is further strengthened by the fact that the true type (Dr. L. writes) shows no trace of having had the mouth opened for examination of the molars; finally, when Peters wrote that there is only "ein einziges Originalexemplar," it was, from his standpoint, a mistake, for on sending Spix's bats back to Munich he wrote (letter dated 10 Dec. 1865): "2 St. *Artibeus perspicillatus* Geoffr. = *Phyll. planirostre* Spix! Original."

As a final result: there is one type only of Spix's *Ph. planirostre* still in the collection of the Munich Museum; this specimen has  $\frac{2}{3}$  molars, and the forearm 58.5 mm.: both facts are decisive evidence that it is the bat called *A. p. planirostris* in this paper; Wagner's and Peters's statement that it has  $\frac{3}{2}$  molars is a

mistake, due to their having examined the teeth not of the true type, but of specimens of *A. jamaicensis lituratus* also collected by Spix at Bahia. It has been of importance, from a purely nomenclatural point of view, to have this question definitely settled; if Wagner and Peters were right, Spix's *Ph. planirostre* would have been a synonym of *A. jamaicensis lituratus*, whereas the species hitherto called *A. planirostris* would have had to stand as *A. fallax* Pet.

Maximilian of Wied's *Phyllostoma obscurum*, 1826.—Type from "Villa Vigosa am Flusse Peruhype," i. e. Parahyba, province of Rio de Janeiro. Judging from the description there can only be the question whether this is *A. planirostris planirostris* or *A. jamaicensis lituratus*. The number of "Backenzähne im Oberkiefer" is

*Measurements of Artibeus planirostris planirostris.*

	Brazil (Matto Grosso, Bahia, Pernambuco, Marañhão, Pará).		Venezuela (La Guaira).		S. Mexico (Chiapas, Guerrero).	
	16 adults, 11 skulls.		3 adults, 3 skulls.		3 adults, 3 skulls.	
	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
Skull, total length, to front of c...	mm. 27.5	mm. 30	mm. 27.5	mm. 29	mm. 27	mm. 28.3
" mastoid width .....	14.8	16	15.2	15.3	14.8	14.9
" width of brain-case .....	12.2	13.2	12.8	13	12	12.6
" zygomatic width .....	16.8	18.5	17	17.7	16.8	17.5
" maxillary width, across m...	12.2	13.2	12.8	13	12.1	12.7
" across cingula of canines...	7.8	8.2	8.1	8.4	7.8	8
Mandible, to front of inc. ....	19.3	20.8	19.5	20	19	19.2
Upper teeth, c-m <sup>2</sup> .....	9.9	10.8	10.1	10.7	10.1	10.2
Lower teeth, c-m <sub>3</sub> .....	10.8	11.8	11.2	11.8	11	11
Ear-conch, length, inner margin	15.2	16.8	15.7	16.5		
" length, outer margin .....	21	23.6	21.5	22.5		
" width .....	14.5	16	14	14.5		
Tragus, length .....	7.2	7.8	6.8			
Lancet, length .....	8	10.5	9	10.5		
" width .....	6.8	7.8	6	6.8		
Horseshoe, width .....	7.2	9	7.7	7.7		
Forearm .....	57.8	65.2	58.8	61.2	60	62.2
Pollex .....	13.8	15.6	13	14.5	...	15.8
3rd metacarpal .....	50.8	59	54	54.8	54.7	55.2
III <sup>1</sup> .....	17	20.2	17	18.8	16.8	18.5
III <sup>2</sup> .....	26.2	32.8	29.5	30	28.5	31.2
III <sup>3</sup> .....	15	18.8	14.7	16.2	15	16
4th metacarpal .....	50	57.8	52.2	54	53	53
IV <sup>1</sup> .....	15	17.8	14.7	16.2	15	16.2
IV <sup>2</sup> .....	17.5	22	19.2	20	18	19
5th metacarpal .....	51.8	59.7	54.2	55.2	54.3	56
V <sup>1</sup> .....	11.5	14	11.3	12	12	13.5
V <sup>2</sup> .....	13	17.7	14.2	15.2	13.5	16
Interfemoral .....	15	21	12	12.8		
Lower leg .....	21.8	25	21.7	22.5	21.8	23.2
Foot, with claws .....	15	17.2	14.7	15.8		
Calcar .....	6.5	8.2	7.5	7.8	5.5	6.5

stated to be "vier auf jeder Seite"; if this is correct, the bat is *A. j. lituratus*. But three points make me hesitate to draw this conclusion:—first, Prince Maximilian describes the incisors and canines of *Ph. obscurum* tolerably well, but passes very lightly over the molars; if his examination of these latter has been similarly cursory, he may very easily, indeed, have overlooked the rudimentary m<sup>3</sup>: second, the length of the head and body is stated to be "3''"; it would seem to be too small for an *A. j. lituratus*, but would agree very well with *A. p. planirostris*: third, he describes in the same book a "*Ph. superciliatum*," also from Rio de Janeiro, which probably is *A. j. lituratus*, and it might seem rather unlikely that he has described, a few pages later, a specimen of the same form as *Ph. obscurum*; this latter argument is, however, rather weak; the possibility is not quite excluded that *Ph. superciliatum* might be the light "phase," *Ph. obscurum* the dark "phase" of one species; but the other evidence speaks against this assumption. Only a re-examination of the type of *Ph. obscurum*, if it still exists, can place the identification beyond doubt.

#### ARTIBEUS PLANIROSTRIS TRINITATIS K. And.

1893. *Artibeus planirostris* Spix, Thomas, Journ. Trinidad Field Nat. Club, i. no. 7, p. 6 (April 1893).—Trinidad.  
 1897. *Artibeus planirostris* Spix, J. A. Allen & Chapman, Bull. Am. Mus. N. H. ix. Art. ii. p. 15 (26 Feb. 1897).—Trinidad.  
 1906. *Artibeus planirostris trinitatis* Knud Andersen, Ann. & Mag. N. H. (7) xviii. p. 420 (1 Dec. 1906).—Type locality: Trinidad.

*Diagnosis*.—Similar to *A. p. planirostris*, but averaging smaller, with slightly smaller skull and teeth.

*A. p. trinitatis* and *planirostris*.—*A. p. trinitatis* can only be discriminated from its nearest relative, *A. p. planirostris*, by average characters. In *A. p. trinitatis* the forearm and metacarpals average about 4 mm., the tibia 1.5 mm. shorter; the ears are, generally, a little smaller; the average difference in the size of the skull and teeth is very small. For further details see table of measurements, below p. 246.

*Specimens examined*.—13 specimens (6 skins) and 9 skulls, from the following localities:—

British Museum:—Trinidad (5).—Tobago (2).—5 skulls, representing both localities.

U.S. National Museum\*:—Trinidad (6).—4 skulls.

*Range*.—The islands of Trinidad and Tobago, W.I.

#### ARTIBEUS PLANIROSTRIS GRENADENSIS K. And.

1906. *Artibeus planirostris grenadensis* Knud Andersen, Ann. & Mag. N. H. (7) xviii. p. 420 (1 Dec. 1906).—Type locality: Grenada, W.I.

*Diagnosis*.—In the size of the skull and teeth very similar to

\* U.S. N. M. nos. 101898-99 104016, 104018, 104022-23.

*A. p. planirostris*, in external dimensions rather intermediate between *A. p. trinitatis* and *planirostris*.

*A. p. grenadensis* and closely allied forms.—The skull, teeth, and external dimensions of *A. p. grenadensis* average somewhat larger than in its nearest relative, *A. p. trinitatis*. The size of the skull and teeth is almost quite as, or if anything still a trifle larger than, in *A. p. planirostris*, but externally *A. p. grenadensis* averages somewhat smaller than this latter race. For details see the table of measurements, p. 246.

Though undoubtedly an offshoot of the Trinidad-Tobago race, this form has almost reversed to the size of the continental *A. p. planirostris*; practically it is difficult to discriminate *A. p. grenadensis* from this latter. But even if it were proved that *A. p. grenadensis* is, also in average characters, completely similar to the Venezuelan and Brazilian *A. p. planirostris*, it would be reasonable to keep it separate; there is only one other alternative, viz. to unite *A. p. planirostris*, *trinitatis*, and *grenadensis* into one "race," as opposed to the unquestionably much more different *A. p. fallax*; but this would obliterate the two facts that passing from Venezuela to Trinidad-Tobago there is a decrease in the average size of the individuals, and passing from Tobago to Grenada there is, again, an increase in the average size,—facts which seem to me worth recording and, if so, are to be expressed in the technical names of these bats.

*Specimens examined*.—11 specimens (6 skins) and 8 skulls, from the following localities:—

British Museum:—Grenada, W.I. (5).—2 skulls.

U.S. National Museum\*:—Grenada, W.I. (6).—6 skulls.

*Range*.—As yet recorded only from the island of Grenada, Windward Isles, W.I.

#### ARTIBEUS PLANIROSTRIS FALLAX Pet.

1865. *Artibeus fallax* Peters, MB. Akad. Berlin, pp. 355–57.—Type locality: Guiana.  
 1878. *Artibeus planirostris* Spix (partim), Dobson, Cat. Chir. Brit. Mus. p. 517.—British Guiana.  
 1898. ? *Artibeus planirostris* Spix, Thomas, Boll. Mus. Torino, xiii. no. 315, p. 3 (18 April, 1898).—Caiza, Tarija, S. Bolivia.  
 1901. *Artibeus planirostris* Spix, Thomas, Ann. & Mag. N. H. (7) viii. p. 143 (Aug. 1901).—Kanuku Mts., B. Guiana (specimens examined).  
 1901. *Artibeus planirostris* Spix, Thomas, Ann. & Mag. N. H. (7) viii. p. 191 (Sept. 1901).—Para (specimen examined).  
 1902. ? *Artibeus hercules* Rehn, Proc. Acad. N. Sci. Philad. pp. 638–39 (12 Oct. 1902).—E. Peru.  
 1904. ? *Artibeus planirostris* Spix, J. A. Allen, Bull. Am. Mus. N. H. xx. Art. xxix. (8 Oct. 1904).—Ciudad Bolivar, Venezuela.  
 1907. *Uroderma validum* D. G. Elliot, Field Col. Mus., Publ. no. 115, Zool. Ser. vol. viii. pp. 537–38, fig. 74 (skull).—Cayenne.

*Diagnosis*.—Similar to *A. p. planirostris*, but averaging considerably larger.

*A. p. fallax* as compared with the other races.—*A. p. fallax* is the most completely differentiated of the four races of *Artibeus*

\* U.S. N. M. nos. 111510, 111513–14, 111517, 111519, 111523.

*planirostris* described in this paper. The largest skull available is 3 mm. longer, 2.3 mm. broader (zygomatic width) than the largest skull of *A. p. planirostris*; the upper tooth-row, in the largest specimen, is 1.2 mm. longer than in the largest *A. p. planirostris*; there is approximately the same difference between the smallest skull of *A. p. fallax* and the smallest of *A. p. planirostris*, and the average difference in the size of the skull and teeth is, consequently, very well marked. The difference in the external dimensions is equally pronounced, *A. p. fallax* being, as a rule, noticeably larger than *A. p. planirostris*. See the table of measurements, p. 246.

I have had no real difficulty in discriminating any individual of *A. p. fallax*, in the whole large series examined, from *A. p. planirostris*; only one unusually small specimen of the former race from Demerara (B.M. no. 75.11.3.17) caused me some hesitation. Nevertheless, *A. p. fallax* cannot, in my opinion, be separated as a distinct species, but only as a local race of *Artibeus planirostris*, for the following reasons:—First, there is no structural difference, in any respect, between *A. p. fallax* and the other races; second, small individuals of *A. p. fallax* come so exceedingly near to large individuals of *A. p. planirostris* that there can be no doubt that, occasionally, the two forms will prove to be practically quite indistinguishable; third, some examples of *A. p. fallax* from the Lower Orinoco Valley (Ciudad Bolívar) and Para show decidedly leanings towards *A. p. planirostris*, and there at least, in the border districts between the areas occupied by the two races, they will, no doubt, be found to intergrade.

*Specimens examined*.—55 specimens (42 skins) and 36 skulls, from the following localities:—

British Museum:—Para (2).—French Guiana: Cayenne (8).—British Guiana: Demerara (6); Comachka, Demerara River (5); Essequibo River (20); Kanuku Mts., about 59° W., 3° N. (11); B. Guiana (1).—Lower Orinoco: La Vuelta, Ciudad Bolívar (2).—36 skulls, from all the localities enumerated.

*Range*.—Guiana, extending southward to Para, where it meets *A. p. planirostris*, northward to the Lower Orinoco Valley, where it also meets *A. p. planirostris*.

If Rehn's *Artibeus hercules*, from E. Peru, and a specimen of *A. p. planirostris* recorded by Oldfield Thomas (*l. s. c.*) from Caiza, S. Bolivia, neither of which has been examined by me, are referable to *A. p. fallax*, the range of this form is considerably more extensive.

Peters's *A. fallax*, 1865.—The species was based on "einem weiblichen Exemplar in Weingeist" from Guiana in the Berlin Museum, and "anderen trockenen Exemplaren" in the Leyden Museum (probably specimens *b* and *c* in Jentink's 'Cat. Syst. Mamm.' p. 208, 1888). According to Peters (*l. s. c.*) *A. fallax* is in size, in the form of the ears and nose-leaves, and in colour "dem *A. perspicillatus* [*A. jamaicensis* of the present paper]



täuschend ähnlich und gewiss auch schon oft mit ihm verwechselt worden," but differs in the following respects: "Der untere Rand des Hufeisens ist länger, deutlicher abgesetzt und fein gekerbt. Das Gebiss ist namentlich dadurch verschieden, dass der zweite obere wahre Backzahn am hinteren Rande hinter dem Zacken des Cingulums [cusp 5 of this paper] viel tiefer eingebuchtet ist, und dass hier ein sehr kleiner fünfter Backzahn sich hineinlegt."—This statement, taken together with the locality, leaves no doubt as to the identification of *A. fallax*.

Rehn's *A. hercules*, 1902.—Type locality: Eastern Peru; two specimens (one skull). Its "general characters" were summed up by Rehn (*l. s. c.*) as follows:—"Allied to *A. planirostris* (Spix), but differing in the larger size, the much larger foot, and in numerous dental characters." These latter are thus described:—"Second upper premolar subquadrate in basal outline, quite different from the subpyriform tooth of *A. planirostris*, the internal node well developed and forming a conspicuous cusp. First upper molar broad, deep, the anterior inner angle more developed than in *A. planirostris*, which species has this portion rounded. Second lower premolar very heavy and broad, the posterior internal border with the dentate ridge low. First lower molar subquadrate in outline." Upper tooth-row 12, lower tooth-row 12.5, maxillary width across  $m^1$  14.5 mm.; forearm 65.2, 3rd metacarpal 61.5, tibia 24 mm.

Rehn had for comparison two *A. planirostris* from "Chapada [Matto Grosso], Brazil"; so it was quite natural that he found the large, large-skulled and large-toothed Peruvian bat considerably different in size. But if he had been able to compare it with *A. p. fallax*, he would have seen that the size of the two Peruvian examples is in every respect precisely as in the Guianan form described long ago by Peters. If, further, he had had a tolerably good series of skulls of *A. p. fallax* and *A. p. planirostris*, he would have realised that the dental characters as derived from the single skull of *A. hercules* examined by him have neither specific nor subspecific importance, but are individual peculiarities, found in any form of *A. planirostris* (as, indeed, they are found also in the various forms of *A. jamaicensis*). As to this latter point I subjoin the following details:— $p^4$ , in a series of six skulls of *A. p. fallax* (B.M. nos. 3.4.5.22–27), all of adult individuals, none with the teeth much worn, all from Cayenne and taken almost on the same date: basal outline subpyriform in two skulls; subquadrate with strongly rounded inner margin, in one; subquadrate with slightly rounded inner margin, in one; subquadrate with straight inner margin, in one; strongly subquadrate (nearly quadrate) with straight inner margin, in one. The antero-internal cusp on the heel ("internal node," Rehn) of  $p^4$  varies, in this series, from small, through strong, to very strong; the cusp is not always most conspicuous in quite unworn teeth.  $m^1$ , in the same series from Cayenne:—one extreme (two skulls): short antero-posteriorly, broad from side to side, antero-internal angle quite

rounded (this would be, so far as this character is concerned, Rehn's *A. planirostris*); the other extreme in the same series of skulls (one specimen):  $m^1$  long antero-posteriorly, especially in its lingual half, antero-internal angle very sharp, practically rectangular (this would be Rehn's *A. hercules*); in the three remaining skulls the tooth is intermediate in shape. As to  $p_4$  and  $m_2$ , I must confess I do not quite understand Rehn's description, unless "second lower premolar" is a lapsus for first lower molar, and "first lower molar" for second lower molar; there is, of course, no "dentate ridge" on the postero-internal border of  $p_4$  in any bat of the genus *Artibeus*, but there is on  $m_2$ , and the absolute size of the cusps of this dentate ridge (cusps 2 and 3) is subject to notable individual variation.—When entering upon such minute details as here under consideration, we shall scarcely find two skulls of *A. p. fallax* (or any other form of *A. planirostris*) precisely alike; we have passed from the characters useful for a specific or subspecific discrimination to the field of individual variation, and, judging from what I have seen in a large series of skulls of *A. p. fallax*, I should think it highly probable that if Rehn extracted the skull of his second specimen of *A. hercules*, he would find the form of the lingual portion of  $p^4$  or  $m^1$  or both of them slightly differing from that of the corresponding teeth in the single skull described.

It is, of course, quite possible that Peruvian individuals differ in some minor details (or some average characters) from the Guianan *A. p. fallax*; for the present it is at least certain that there is not in Rehn's description one single character by which *A. hercules* can be discriminated from *A. p. fallax*.

Elliot's *Uroderma validum*, 1907.—Type locality: Cayenne. From the figures of the skull, the description and measurements, clearly an *A. p. fallax*. Elliot has apparently been unaware of the fact that the type of *U. validum* (Cayenne) is practically a topotype of *A. p. fallax* Peters (Guiana).

#### ARTIBEUS HIRSUTUS K. And.

1906. *Artibeus hirsutus* Knud Andersen, Ann. & Mag. N. H. (7) xviii. p. 420 (1 Dec. 1906).—Type locality: Michoacan, Mexico.

*Diagnosis*.—Like a small form of *A. planirostris* (though averaging still smaller), but tibia and interfemoral densely haired, and colour of fur of upper side of body in adults drab with a silvery tinge. Maxillary tooth-row 9.5–10.4 mm.; forearm 53.7–59.7 mm.

*Skull and teeth*.—In the skull and teeth there is no essential difference between *A. hirsutus* and a small form of *A. planirostris*, f. i. *A. p. trinitatis*; the rostrum of the skull may, perhaps, average somewhat narrower.—Molars  $\frac{3}{3}$ , as in *A. concolor* and *planirostris*, and as in these species the presence of the small  $m^3$  is almost constant. Eight skulls of *A. hirsutus* have been examined; in two ( $\varnothing$  ad., teeth unworn, Michoacan, U.S. N. M.

Measurements of *Artibeus concolor*, *planirostris*, and *hirsutus*.

	<i>A. concolor</i> .		<i>A. planirostris</i> .												<i>A. hirsutus</i> .					
	♀ ad.		<i>planirostris</i> , 22 adults, 17 skulls.		<i>trinitatis</i> , 13 adults, 9 skulls.		<i>grandcaesi</i> , 9 adults, 8 skulls.		<i>fallax</i> , 41 adults, 33 skulls.		8 adults, 8 skulls.									
	mm.		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Skull, total length to front of c.	22.4		27	30	27.3	28	27.8	28	27.8	28	27.8	28	27.8	28	27.8	28	27.8	28	27.8	28
" mastoid width	11.8		14.8	16	15.1	15.4	15.1	15.4	15.1	15.4	15.1	15.4	15.1	15.4	15.1	15.4	15.1	15.4	15.1	15.4
" width of brain-case	10.3		12	13.2	12.9	12.8	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7
" zygomatic width	14		16.8	18.5	17.6	16.3	17.6	16.8	17.3	18.2	18	18.3	18	18.3	18	18.3	18	18.3	18	18.3
" maxillary width across m <sup>1</sup>	9.4		12.1	13.2	12.9	12.2	12.8	12.5	12.7	13.8	13.1	13	13.1	13	13	13.1	13	13.1	13	13.1
" across zygula of canines	6.4		7.8	8.4	8.2	7.7	8.3	8	8.2	8.8	8.5	8.6	8.5	8.6	8.5	8.6	8.5	8.6	8.5	8.6
Mandible, to front of inc.	14.8		10	20.8	20.1	18.8	10.3	10.4	20	21	20.5	20.8	21	20.8	21	20.5	20.8	21	20.5	20.8
Upper teeth, c-m <sup>2</sup>	7.2		9.9	10.8	10.3	9.8	10.3	10	10.3	11	10.8	10.4	11	10.8	11	10.8	10.4	11	10.8	10.4
Lower teeth, c-m <sup>3</sup>	8		10.8	11.8	11.3	10.6	11.3	10.9	11.2	12	11.6	11.7	12	11.6	12	11.6	11.7	12	11.6	11.7
Ear-conch, length, inner margin.	13		15.2	16.8	16.1	14.2	15.6	14.6	13.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8
" length, outer margin.	17.7		21	23.6	23.2	20.5	21.8	21	20.5	21.5	21.5	21	20.5	21.5	21.5	21	20.5	21.5	21.5	21
" width.	14		14	16	14.9	13.8	15	14.6	13.8	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5
Tragus, length	6		6.8	7.8	7.4	7	7.5	7.1	7	7.5	7.5	7	7.5	7.5	7	7.5	7	7.5	7.5	7
Launcet, length	9.8		8	10.5	9.6	9	10.5	9.8	9	10	10	9.8	10	10	9.8	10	9.8	10	9.8	10
" width	6		6	7.8	7	6.2	7.2	6.9	6.2	7	7	7	7	7	7	7	7	7	7	7
Horseshoe, width	6.8		7.2	9	8.1	7.7	8	7.7	7.5	8	8	8.3	8	8.3	8	8.3	8	8.3	8	8.3
Forearm	50		57.8	65.2	61.8	55	60	57.7	57.5	61.3	59.4	62.8	59.4	62.8	59.4	62.8	59.4	62.8	59.4	62.8
Pollex	13.8		13	15.8	14.5	13.5	14.8	14.1	14	15.5	14.5	14.2	15.5	14.2	15.5	14.2	15.5	14.2	15.5	14.2
3rd metacarpal	46.7		50.8	59	55.6	48	55.2	51.7	52.5	56	54.3	53.5	56.7	53.5	56.7	53.5	56.7	53.5	56.7	53.5
III <sup>1</sup>	16		16.8	20.2	18.5	16	19.2	17.5	17	19	17.9	17.8	19	17.8	19	17.8	19	17.8	19	17.8
III <sup>2</sup>	24		26.2	32.8	30.1	26	29.5	28.2	27.2	31	29.2	27.5	31	29.2	27.5	31	29.2	27.5	31	29.2
III <sup>3</sup>	13.2		14.7	18.8	16.4	14.7	17	15.5	14.2	17	15.5	15.8	17	15.5	15.8	17	15.5	15.8	17	15.5
4th metacarpal	45		50	57.8	54.7	46	53.5	50.1	50.8	55	53	52.8	55	53	52.8	55	53	52.8	55	53
IV <sup>1</sup>	13.2		14.7	17.8	16.2	14.5	16.8	15.4	14.7	16.7	15.7	15	16.7	15.7	15	16.7	15.7	15	16.7	15.7
IV <sup>2</sup>	16.2		17.5	22	19.9	18	20	19.1	17.7	20.7	19	20	22.1	19	20	22.1	19	20	22.1	19
5th metacarpal	45.2		51.8	59.7	56	49.3	54.8	51.6	52.5	56.5	54.3	54.2	56.5	54.3	54.2	56.5	54.3	54.2	56.5	54.3
V <sup>1</sup>	11.5		11.5	14	12.3	11	12.7	11.5	10.8	12.7	11.7	11.8	15	11.8	15	11.8	15	11.8	15	11.8
V <sup>2</sup>	13.2		13	17.7	15.5	12	15.2	14.4	13.5	16	14.5	16	14.5	16	14.5	16	14.5	16	14.5	16
Interfemoral	12.7		12	21	16.8	12	18	14.5	16	19	23.5	22	26	20.5	19.1	23	22	26	20.5	19.1
Lower leg	18.6		21.7	25	22	20.2	22.2	21.4	21.2	23.5	22.5	22	26	20.5	19.1	23	22	26	20.5	19.1
Foot, with claws	11.8		14.7	17.2	16.1	14.7	16.5	15.5	15	16.5	15.8	15	16.5	15.8	15	16.5	15.8	15	16.5	15.8
Calcus	6.8		5.5	8.2	7.5	5.5	7.8	7.1	6.7	7.8	7.3	6.5	8.2	6.5	8.2	6.5	8.2	6.5	8.2	6.5

no. 126451; and ♂ ad., teeth slightly worn, Colima, U.S. N. M. no. 52091) m<sup>3</sup> and its alveolus are wanting on one side, in none on both sides.

*Nose-leaves*.—Of eight specimens examined, four are preserved in alcohol; in one of these latter the front margin of the horse-shoe is free, but narrow; in three it is almost continuous with the integument of the muzzle. Thus there is in this species the same variation in this respect as in *A. planirostris* (p. 235) and *A. jamaicensis* (p. 253).

*Tragus*.—About three small, rounded, sometimes almost obsolete serrations above the median projection.

*Wings*.—The metacarpals and phalanges (especially the proximal phalanges) are proportionately a little shorter than in *A. planirostris*. The wing-indices on p. 310 and the table of measurements, p. 246, show the details.

*Hairing on limbs and interfemoral*.—Different from *A. planirostris*. The whole of the interfemoral (above and below) right to the posterior margin, and the upper side of the femur, tibia, and foot are densely haired.

*Colour*.—General impression: much more drab above and lighter beneath than in any phase of *A. planirostris*.

Upper side dark drab or brownish drab, with very short, almost greyish-drab tips to the hairs, giving the whole of the upper side a peculiarly silvery tinge; base of hairs of hinder back grey with a tinge of ecru-drab, in the shoulder region and on the neck noticeably lighter, whitish ecru-drab. Under side smoke-grey with conspicuous white tips to the hairs. Supraorbital stripes indistinct or none.

*Specimens examined*.—8 specimens (4 skins), with skulls, from the following localities:—Michoacan: La Salada (3); Colima: Colima (3); Jalisco: Etzatlan (1); W. Mexico (1).—All from the collection of the U.S. National Museum\*.

*Range*.—As yet only known from the States of Michoacan, Colima, and Jalisco, Mexico.

#### ARTIBEUS JAMAICENSIS Leach.

*Diagnosis*.—Molars  $\frac{2}{3}$ . Maxillary tooth-row 9.3–12.2 mm. Forearm 54–76 mm.

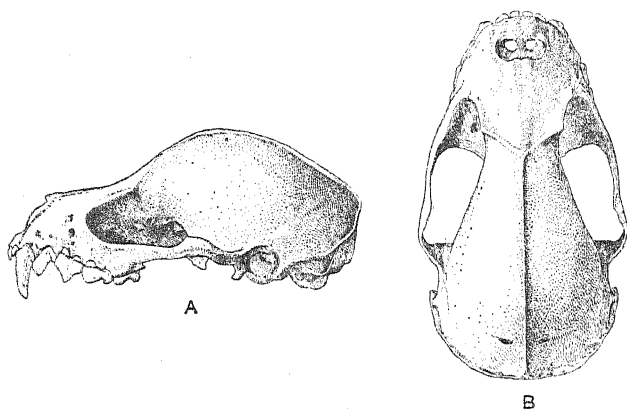
*Skull*.—Similar in shape to that of *A. planirostris*. In the largest race of *A. jamaicensis* (viz. *A. j. lituratus*) the size of the skull is practically as in the largest form of *A. planirostris* (*A. p. fallax*), though averaging still a trifle more heavily built; so complete is the resemblance that certain skulls of *A. j. lituratus* would be indistinguishable from those of *A. planirostris*, were it not for the absence of the small m<sup>3</sup>. In the smallest races of *A. jamaicensis* (*A. j. parvipes* and *yucatanicus*) the skull is as small and delicately built as (or, if anything, still smaller than) in *A. planirostris trinitatis* or *A. hirsutus*.

The skull, especially its facial portion, is in certain races of

\* U.S. N. M. nos. 9052 (36880), 52063, 52091, 52092, 52101, 126448–49 126451.

*A. jamaicensis* subject to considerable modification dependent on the age of the individuals; one of these modifications has served as type for the description of a distinct species (J. A. Allen's *A. intermedius*). The text-figures below show, approximately, the two

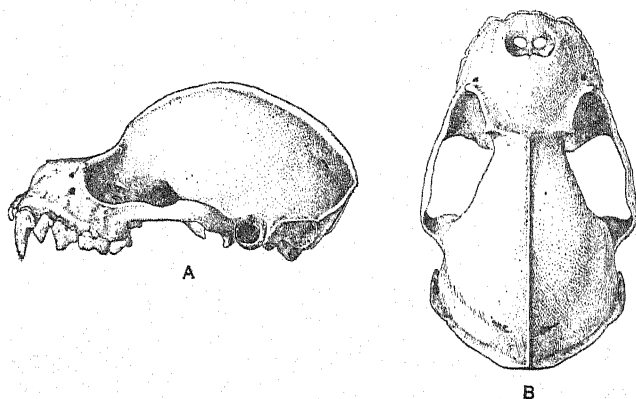
Text-fig. 50.



*Artibeus jamaicensis palmarum*, ♀ ad. Macuto, Venezuela, July 14, 1900.  
U.S. N. M. 102845.

A. Lateral, B. Upper view of skull.  $\times \frac{3}{2}$ .

Text-fig. 51.



*Artibeus jamaicensis palmarum*, ♂ ad. Macuto, Venezuela, July 14, 1900.  
U.S. N. M. 102843.

A. Lateral, B. Upper view of skull.  $\times \frac{3}{2}$ .

extremes in the shape of the skull in adult individuals (in some skulls examined the old age modification is carried still a little

farther than represented in fig. 51):—the two skulls of *A. j. palmarum* figured are from the same place (Macuto, La Guaira, Venezuela); the one (fig. 50) is of an adult female with the distal epiphyses of the metacarpals ossified, but the teeth unworn, *i. e.* a mature but young individual; the other (fig. 51) an older male with somewhat worn teeth: these two skulls have been selected as paradigmata, because they belong to the same geographical race of *A. jamaicensis* and were obtained precisely at the same locality; but perfectly similar extremes are found in other skulls of the series examined, and not only in *A. j. palmarum* but in *A. j. lituratus* as well (f. i. in a British Museum series of this latter race from Sapucay, Paraguay). The skulls figured are, the one of a female, the other of a male, but the modifications have nothing to do with sexual differences. In the rather younger individual (fig. 50) the brain-case makes the impression of being lower, the naso-frontal depression (on the dorsal face of the rostrum, in front of the sagittal crest) is shallow; the supraorbital ridges, where starting from the anterior point of the sagittal crest, form an angle with this latter of about  $125^{\circ}$ – $135^{\circ}$ , the postorbital processes are very inconspicuous (in still younger individuals scarcely indicated). In the somewhat older individual (fig. 51) the brain-case makes the impression of being higher, more vaulted, but the difference is more apparent than real, chiefly due to the higher and more forwardly extending sagittal crest. This latter fact, that the sagittal crest has been produced farther forward, has two other effects—first, that the naso-frontal depression (viewed in profile) is more abrupt; second, that the supraorbital ridges are not directed forward and outward, but almost straightly outward, forming an angle with the sagittal crest of very little more than  $90^{\circ}$ ; the postorbital processes are very conspicuous, and a pair of comparatively large anteorbital processes has been developed.

The adult and old age modification of the skull as described above is characteristic of the forms called in this paper the “southern races” of *A. jamaicensis* (*viz. A. j. lituratus, palmarum, praeceps*). The transition from the young to the old stage takes place earlier in some individuals than in others; I have seen individuals with somewhat worn teeth which have still almost the young type of skull, or are only in a transitional stage, while others with almost quite unworn teeth have already reached far on the way towards the old age type.—The “northern” races (*A. j. parvipes, yucatanicus, jamaicensis, aequatorialis*) never, or exceedingly rarely, reach that degree of old age modification of the skull attained by the southern races.

*A. j. parvipes, yucatanicus, jamaicensis*, and *aequatorialis* retain, throughout the whole life, a shape of the facial portion of the skull not very different from that of immature individuals of all races; in *A. j. lituratus, palmarum*, and *dominicanus* the skull of aged individuals is very conspicuously modified. From this it is concluded that the former group of races, in this particular

respect, is slightly more primitive than the latter group. Other facts, to be mentioned hereafter, point to the same effect.

*Teeth.*—As in *A. planirostris*, with the following differences:— $m^3$ , which is rudimentary in *A. planirostris*, has definitely disappeared in *A. jamaicensis*. 185 skulls, of the seven subspecies recognised in this paper, and of practically all ages, from half-grown to very old individuals, have been examined; all of them lack  $m^3$ , and in none is there any trace of the tooth having been present.

$m_3$  is on the whole still somewhat smaller than in *A. planirostris*. When, as is the case in *A. jamaicensis*, the development has reached the point that  $m^3$  is invariably wanting and  $m_3$  reduced to a mere rudiment, it might be anticipated that this rudimentary  $m_3$  would, probably, show some tendency towards complete disappearance. But it must be said at once that individuals lacking  $m_3$  on both sides of the jaw, without any trace of its alveoli, are extremely rare; the remarkable fact is not that such exceptions do occur, but, in view of the minute size of the tooth, that they do not occur more often. In two individuals (a young adult *A. j. jamaicensis* from San Domingo, B. M. no. 50.7.8.43; and a fully adult male, with unworn teeth, of the same race from Peten, Guatemala, U.S. N. M. no. 37912)  $m_3$  is entirely wanting on one side; in four individuals (an adult male, with somewhat worn teeth, of *A. j. palmarum* from Costa Rica, B.M. no. 98.10.9.4; a young female of *A. j. jamaicensis* from Oaxaca, Mexico, U.S. N. M. no. 73255; an aged male, with much worn teeth, of *A. j. jamaicensis* from Morelos, Mexico, U.S. N. M. no. 64482; and an adult male, with unworn teeth, of the same race from Old Providence Island, U.S. N. M. no. 37811) it is wanting on both sides. Thus in 97 p. ct. of the 185 skulls examined  $m_3$  (or its alveolus) is present on both sides, but averaging a little smaller than in *A. planirostris*, in 3 p. ct. it is completely wanting either on one side or on both sides.

In those few species of *Artibeus* which have preserved a rudimentary  $m^2$ , this tooth is situated postero-internally to  $m^2$ , partly fitting into a sharp, subrectangular emargination in the posterior border of this latter tooth, between its cusps 5 and 7 (text-fig. 41 A, on p. 208). What becomes of this angular notch, when, as is invariably the case in *A. jamaicensis*,  $m^3$  completely disappears? It is an interesting fact that in the races of northern origin (*A. j. parvipes*, *yucatanicus*, *jamaicensis*, *aequatorialis*) the emargination is, in 77 p. ct. of the individuals, preserved quite or almost as conspicuous as in any *A. planirostris*, sometimes (in about 19 p. ct.) it is decidedly reduced in size, rarely (4 p. ct.) almost or quite disappeared; whereas in the races of southern origin (*A. j. lituratus*, *palmarum*, *dominicanus*) the emargination has only been preserved, as conspicuous as in *A. planirostris*, in about 10 p. ct.; in 38 p. ct. it is decidedly on the way towards disappearance, in 52 p. ct. it has practically disappeared. Thus, the northern races, though having like their southern relatives

lost  $m^3$ , have in the large majority of individuals preserved the notch in  $m^2$  into which  $m^3$  fitted; they have, consequently, also in this respect remained in a slightly more primitive stage than the southern races, in which the notch, in no less than 90 p. ct. of the individuals, is either conspicuously reduced or quite obliterated.

The disappearance of the sharp angular notch between cusps 5 and 7 of  $m^2$  is *not* effected by a reduction of the large, posteriorly projecting cusp 5 (which would imply a decrease in the area of  $m^2$ ), but, on the contrary, by a filling out of the notch, consequently by a slight increase in the volume of  $m^2$ ; it is as if the loss of  $m^3$  has been compensated by a corresponding, or partly corresponding, addition to that part of  $m^2$  against which the missing  $m^3$  was pressed: in other words, the function of the missing  $m^3$  has, in the more highly developed races of *A. jamaicensis*, been transferred, to a certain extent, to the postero-internal border of  $m^2$  (text-fig. 52).

Text-fig. 52.



A. *Artibeus jamaicensis jamaicensis*, ♀ ad. St. Andrew's I. B.M. 92.12.20.6.

Right  $m^2$ , to show strong emargination of hinder margin of tooth.  $\times \frac{1}{2}$ .

B. *Artibeus jamaicensis lituratus*, ♂ ad. Morretes, Parana. B.M. 3.7.1.127.

Right  $m^2$ , to show slight emargination of hinder margin of tooth.  $\times \frac{1}{2}$ .

Reference has been made above to the fact that of 185 skulls only 6 lack  $m^3$ , either on one side or on both sides of the mandible, and it may be worth the while drawing attention also to the fact that of these 6 aberrant individuals no less than 5 belong to the race *A. j. jamaicensis*. The number of skulls examined of this race is 75, the number of aberrant individuals 5 (about 7 p. ct.); the number of skulls of all other races together is 110, of which only one single individual is aberrant (1 p. ct.). It is probably not quite accidental that in the large series examined the loss of  $m^3$  is less rare in the northern group of races.  $m^3$  in *A. planirostris*, works against the whole surface of the small  $m^2$  and a very narrow postero-internal margin of  $m^2$ . When now, as is the case in the large majority (about 80 p. ct.) of individuals of the northern races of *A. jamaicensis*, there is no compensation at all for the loss of  $m^3$  (i. e., no filling up of the notch in  $m^2$  into which  $m^3$  fitted), then  $m^3$  has exceedingly little or nothing at all to work against in the upper jaw, and it appears quite conceivable that in such circumstances it shows a rather more pronounced tendency to disappearance. In the southern races, on the other



hand, the loss of  $m^3$  is, in the large majority of individuals (about 90 p. ct.), more or less compensated by a slight increase in the postero-internal portion of  $m^2$  (by a filling up, partly or completely, of the notch between cusps 5 and 7), and, consequently,  $m_3$  has almost as much to work against in the upper jaw as in those species which possess an  $m^3$ ; the disappearance of  $m_3$  is, probably for this reason, of extreme rarity in the southern races.

So far as  $m^3$  and the notch in the posterior margin of  $m^2$  are concerned, the various stages represented by *A. planirostris* and *jamaicensis* may be tabulated as follows:—

- (A)  $m^3$  present on both sides: almost all *A. planirostris* (94 p. ct.).  
 (B)  $m^3$  present on one side, entirely wanting on the other: 3 p. ct. of *A. planirostris*.  
 (C)  $m^3$  entirely wanting on both sides: 3 p. ct. of *A. planirostris*; all *A. jamaicensis*.  
 (1) Notch in hinder margin of  $m^2$ , between cusps 5 and 7, perfectly preserved (*i. e.* as distinct as in any *Artibeus* which possesses an  $m^3$ ): the large majority (77 p. ct.) of the individuals of the northern races of *A. jamaicensis* (*A. j. parvipes*, *yucatanicus*, *jamaicensis*, *equatorialis*); a small minority (11 p. ct.) in the southern races (*A. j. lituratus*, *palmarum*, *praeceps*).  
 (2) Notch in hinder margin of  $m^2$  decidedly reduced: a minority (19 p. ct.) in the northern races; a large number (38 p. ct.) in the southern races of *A. jamaicensis*.  
 (3) Notch in hinder margin of  $m^2$  almost or completely filled up: a vanishing minority (4 p. ct.) in the northern; half the number of individuals (51 p. ct.) in the southern races of *A. jamaicensis*.

The subjoined table and diagram are intended to give a view of the gradual reduction of the notch between cusps 5 and 7 of  $m^2$  in the various races of *A. jamaicensis* (one race, *A. j. praeceps*, as being too poorly represented in the collections examined, is excluded from the table; it apparently agrees with its nearest relatives, *A. j. palmarum* and *lituratus*):—

	Total number of skulls examined.	Angular emargination between cusps 5 and 7 of $m^2$		
		quite or almost as conspicuous as in any <i>A. planirostris</i> .	decidedly reduced.	almost or quite disappeared.
<i>parvipes</i> .....	12	92 p. ct.	8 p. ct.	0 p. ct.
<i>yucatanicus</i> .....	10	80 "	20 "	0 "
<i>jamaicensis</i> .....	74	75 "	22 "	3 "
<i>equatorialis</i> .....	8	75 "	12.5 "	12.5 "
<i>lituratus</i> .....	42	12 "	36 "	52 "
<i>palmarum</i> .....	30	10 "	40 "	50 "
Northern races ...	104	77 p. ct.	19 p. ct.	4 p. ct.
Southern races ...	72	11 "	38 "	51 "

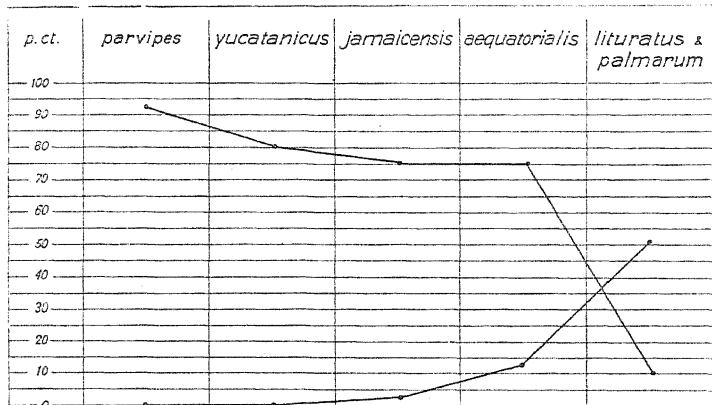


Diagram showing the percentage of individuals, in the races of *Artibeus jamaicensis*, in which the angular emargination between cusps 5 and 7 of  $m^2$  (former place of  $m^3$ ) (1) is quite, or almost, as pronounced as in any *A. planirostris* (upper curve), (2) has almost, or quite, disappeared (lower curve).

*Tragus*.—In most individuals there are 4 or 5 quite small serrations on the outer margin of the tragus, above the median projection; the serrations may be sharp, but as a rule they are more or less rounded off, rather often reduced to inconspicuous nodules; very often the number is reduced to 3 (generally by obliteration of the lower ones), rarely to 2, and still more rarely all serrations are almost obliterated, the margin from the median projection to the tip of the tragus being practically simple. There is every transition between these stages, and they occur in all races.

*Nose-leaves*.—According to Dobson *A. jamaicensis* (*A. perspicillatus* in his 'Catalogue') is "at once distinguished" from *A. planirostris* by having the front margin of the horseshoe "completely bound down to the muzzle, in some individuals even confluent with its integument," whereas in *A. planirostris* the margin is "free, separated from the muzzle, straight, unnotched." This character is thoroughly untrustworthy. First, in the same geographical race of *A. jamaicensis*, often in individuals obtained on the same spot, all transitions can be found, from a horseshoe with the front margin as free as in any *planirostris*, to a horseshoe with the front margin completely continuous with the integument of the muzzle, as shown in the table, p. 254 (based exclusively on specimens preserved in alcohol). Second, in *A. planirostris* the front margin is, as a rule, more or less free, but individuals occur in which it is so completely bound down as to be almost confluent with the integument of the muzzle.—The front margin of the horseshoe is often simple, sometimes more or less crenulate; the crenulations extend not rarely over the whole of the lateral margins, sometimes even over a smaller or greater

part of the lancet. The lateral margins of the horseshoe are sometimes turned up so as to form a fold; in some individuals they even show some indications of an emargination.

	Front margin of horseshoe		
	quite, or almost, as free as in any <i>A. planirostris</i> .	rather more definitely fastened down, but still distinctly projecting.	almost completely, or quite completely, fastened down to, or confluent with, muzzle.
<i>parvipes</i> .....	Cuba (2).	Cuba (10).	Cuba (4).
<i>yucatanicus</i> .....	.....	Yucatan (3).	Yucatan (1).
<i>jamaicensis</i> .....	Honduras (1). Old Providence I. (2). Jamaica (1). Porto Rico (6).	Nicaragua (1). Honduras (1). Guatemala (1). Campeche (3). Chiapas (1). Vera Cruz (1). Old Providence I. (2). Jamaica (5). Porto Rico (5). St. Kitts (1).	Nicaragua (1). Chiapas (2). Oaxaca (2). Vera Cruz (1). Morelos (3). San Domingo (1). Porto Rico (1).
<i>aequatorialis</i> .....	.....	Ecuador (1).	
<i>lituratus</i> .....	Paraguay (1).	Paraguay (1). Parana (1). Para (1).	Paraguay (5). Sta. Catharina (1).
<i>palmarum</i> .....	Venezuela (2). St. Vincent I. (1).	Venezuela (2). Costa Rica (1). Nicaragua (1). Guatemala (1).	Trinidad (2). Costa Rica (3). Guatemala (3). Jalisco (1).
<i>præceps</i> .....	.....	Guadeloupe (2).	Dominica (1).
All races (94) ...	18 p. ct.	48 p. ct.	34 p. ct.

*Wing-indices*.—The proportionate length of the metacarpals and phalanges is quite as in *A. planirostris*; so complete is the similarity that the wing-indices of the latter species could be substituted for those of *A. jamaicensis* without any appreciable error (see the table on p. 310).

*Hairing on limbs and membranes*.—Upper side of proximal two thirds (or half) of forearm, upper side of lateral membranes next to body, of metacarpal of pollex, of femur, tibia, foot, and inter-femoral (a narrower or broader distal portion excepted), under side of proximal half of forearm and of proximal portion of inter-femoral, very distinctly haired.

In the northern races the upper side of the tibia and inter-femoral are generally more sparsely haired than in the southern races, sometimes almost naked.

*Colour*.—There is often a certain colour difference between

younger and aged individuals; further, some variation in the development of the supraorbital and infraorbital stripes, partly quite individual, partly dependent on age, and partly on the race to which the individuals belong; and last, there is a certain colour difference between *A. j. parvipes*, *yucatanicus*, *jamaicensis*, and *aequatorialis* (i. e. the northern races) on one side, *A. j. lituratus* and *palmarum* (the southern races) on the other side. It has therefore proved convenient to give the description of the coloration under the following five headings:—dark-coloured individuals; lighter-coloured individuals; indication of dorsal stripe and white ear-edgings; facial stripes; concluding remarks on the colour.

*Dark-coloured individuals.*—Upper side, from the shoulder region backward, dark smoky brown, almost blackish brown, this colour confined to the distal third or fourth of the hairs; base of hairs slate. On the anterior part of the upper side, from the shoulder region forward, the hair-bases are as a rule distinctly lighter, almost smoke-grey. Under side dark smoke-grey or brownish smoke-grey, with a peculiarly grizzled appearance, owing to the short whitish or greyish-white tips to the hairs. Tips of wings (region of third, or second and third phalanges of third digit) generally light-coloured (whitish or yellowish white).

This is the extreme of the dark colour-type in fully adult individuals (young, not full-grown individuals are still a shade darker or duller). It occurs in *all* races, but is especially common, and much more frequently retained (or retained in a slightly lighter shade) throughout the whole life, in the northern than in the southern races; about 75 p. ct. of the fully adult specimens examined of the northern races are “dark,” as against only 25 p. ct. in the southern races. By advancing age (the precise period varying considerably) the colour becomes gradually of a somewhat lighter shade, even in those individuals which never assume the proper “light phase” described below.

*Lighter-coloured individuals.*—Upper side, from shoulder region backward, Prout's brown, base of hairs almost wood-brown. On the shoulder region and neck the Prout's brown hair-tips are generally very short or altogether wanting, the wood-brown ground-colour of the fur therefore more or less, or completely, exposed, producing an often very strong contrast between the anterior and posterior parts of the dorsal surface. Under side dull brown, base of hairs very little, or not at all, lighter; extreme tips of hairs generally whitish or greyish white. Tips of wings as in dark-coloured individuals.

This is very nearly the extreme of the light colour. The hair-bases on the shoulder region and neck are in some specimens still lighter than “wood-brown,” almost yellowish white.

The dark extreme described above and the light extreme here under consideration are very different indeed, but there is absolutely no sharp line of separation between them; they are connected by many intermediate stages. Putting aside all

variations of shade, the principal stages are these three: dark smoky brown (dark type), Vandyck-brown (intermediate stage), Prout's brown (light type).

The light colour type occurs in *all* races, but much more frequently in the southern than in the northern races; about 75 p. ct. of the fully adult specimens examined of the southern races (representing many different stages of wear of the teeth) are light-coloured, as against only 25 p. ct. of the northern races.

The subjoined table (p. 257) gives a statistical view of the number of dark and light coloured individuals in the large series examined. It is based exclusively on fully adult individuals (distal epiphyses of metacarpals ossified), and exclusively on dried skins, no spirit-specimens, however well preserved, having been taken into account. It will be noticed that 62 p. ct. of the available individuals of the southern races have the teeth from slightly worn to much worn, whereas the same is the case with a somewhat smaller percentage (50 p. ct.) of the northern races; it may, perhaps, have slightly exaggerated the final results, but a glance at the table will be sufficient to prove that it cannot have had any essential influence on the conclusions, which may be epitomised as follows:—(1) Light-coloured individuals are much more common in the southern than in the northern races: (2) of 30 individuals of the northern races which, though fully adult, have the teeth unworn or practically unworn, 28 are dark-coloured; of 20 individuals of the southern races, of corresponding age, only half the number are dark-coloured: (3) of 20 specimens of the northern races with the teeth slightly or somewhat worn, 12 are dark-coloured; of 18 specimens of the southern races of corresponding age, none are dark-coloured: (4) of 9 specimens of the northern races with the teeth well worn or much worn, 4 are dark-coloured; of 15 specimens of the southern races of corresponding age, 2 only are dark-coloured. These two conclusions therefore, would seem to be well founded: that there is a well-marked average difference of colour between northern and southern races; and that the light colour type, though sometimes (particularly in the southern races) occurring in adult individuals with unworn teeth, is especially characteristic of the somewhat more advanced age.

Immature individuals are always dark-coloured; of the northern races the large majority of adult and aged individuals are dark-coloured, of the southern races a minority only. From this it is concluded that the northern races have also in this respect remained in a slightly more primitive stage than the southern forms. One of the following paragraphs will show that a closer study of the development of the head-stripes in these two groups of races leads to the same conclusion.

*Indication of dorsal stripe and white ear-edgings.*—One specimen of *A. j. jamaicensis* (♀ ad., San Vicente, Chiapas, Mexico, teeth much worn, fur rather light-coloured, U.S. N. M. no. 133044) has a short longitudinal stripe on the hinder part of the back.

*Dark and light coloured individuals.*

	Total number of skins of adults.	Teeth			All ages of fully adult individuals.
		unworn or practically unworn.	slightly or somewhat worn.	well worn or much worn	
<i>parvipes</i> .....	9	darker 3, lighter 0.	darker 3, lighter 1.	darker 2, lighter 0.	darker 8, lighter 1.
<i>yucatanicus</i> .....	9	darker 5, lighter 0.	darker 1, lighter 3.	...	darker 6, lighter 3.
<i>jamaicensis</i> .....	36	darker 19, lighter 2.	darker 7, lighter 3.	darker 1, lighter 4.	darker 27, lighter 9.
<i>aequatorialis</i> .....	5	darker 1, lighter 0.	darker 1, lighter 1.	darker 1, lighter 1.	darker 3, lighter 2.
<i>titularatus</i> .....	30	darker 9, lighter 6.	darker 0, lighter 10.	darker 1, lighter 4.	darker 10, lighter 20.
<i>palmarum</i> .....	23	darker 1, lighter 4.	darker 0, lighter 10.	darker 1, lighter 9.	darker 2, lighter 21.
Northern races ...	59	darker 28, lighter 2.	darker 12, lighter 8.	darker 4, lighter 5.	darker 75 p. ct. lighter 25 p. ct.
Southern races ...	53	darker 10, lighter 10.	darker 0, lighter 18.	darker 2, lighter 13.	darker 23 p. ct. lighter 77 p. ct.

The anomaly is worth noticing, because it recalls the white dorsal stripe characteristic of many species of the more primitive genus *Vampyrops* (and of *Uroderma*).

A few individuals show some slight trace of a narrow white margin to the ears, a feature of common occurrence in those species of *Artibeus* which possess  $\frac{2}{3}$  molars.

*Facial stripes.*—Many individuals have two pairs of whitish or yellowish-white, longitudinal stripes on the head, viz. a pair of supraorbital stripes from the base of the lancet, passing above the eye, to a point above the inner side of the ears; and a pair of infraorbital stripes from the angle of the mouth to the outer base of the ears.

There is every stage of transition, from complete absence to very strong development, of these facial stripes. A certain correlation exists between the development of the supraorbital and infraorbital stripes; very strong supraorbital stripes are almost always associated with well-marked infraorbital stripes, faint supraorbital stripes with completely wanting or indistinct infraorbital stripes. The infraorbital stripes are, almost invariably, markedly fainter (narrower, or more indistinct) than the supraorbital stripes.

Immature individuals have the facial stripes less well marked than adult or aged examples. As to fully adult and aged individuals, there is a difference in the development of the facial stripes between the northern and southern races, and a difference

between dark-coloured and light-coloured specimens:—Of 59 fully adult examples (skins) of the northern races, 53 have the supraorbital stripes perfectly wanting or but very faintly indicated; in 4 they are distinct, in 2 strong; compare with this the southern races: of 53 fully adult examples (skins) 3 have these stripes faint (or quite undeveloped), 1 distinct, and no less than 49 strong or very strong. In all individuals of the northern races the infraorbital stripes are quite wanting or, at most, very faintly indicated; in more than half the number of skins of the southern races (32 of 53) they are also faint or undeveloped, but in 15 they are distinct, and in 6 strong.—That strong facial stripes are much more frequently associated with light than with dark colour of the fur is proved by the following statistics:—Of the dark-coloured individuals of the northern races scarcely 5 p. ct., of the light-coloured individuals of the same races about 25 p. ct., have the supraorbital stripes well developed; of the dark-coloured individuals of the southern races 75 p. ct., of the light-coloured individuals 100 p. ct., have the supraorbital stripes well developed.—More extensive material than I have been able to bring together may, of course, alter these figures somewhat, in one or other direction, but it is not likely that it will alter the general conclusion to any essential degree.—The subjoined table gives the details (compare diagram p. 259).

From the two facts, viz. (1) that the facial stripes are less developed in immatures than in adults, less developed in the dark

*Facial stripes.*

	Total number of skins of adults.	Supraorbital stripes			Infraorbital stripes		
		none or faint.	distinct.	strong or very strong.	none or faint.	distinct.	strong or very strong.
<i>parvipes</i> , dark .....	8	8	0	0	8	0	0
„ light .....	1	0	1	0	1	0	0
<i>yucatanicus</i> , dark ...	6	6	0	0	6	0	0
„ light ...	3	2	1	0	3	0	0
<i>jamaicensis</i> , dark ...	27	26	1	0	27	0	0
„ light ...	9	8	1	0	9	0	0
<i>æquatorialis</i> , dark ...	3	2	0	1	3	0	0
„ light ...	2	1	0	1	2	0	0
<i>lituratus</i> , dark .....	10	3	0	7	9	1	0
„ light .....	20	0	1	19	12	4	4
<i>palmarum</i> , dark .....	2	0	0	2	1	1	0
„ light .....	21	0	0	21	10	9	2
N. races, dark .....	44	42	1	1	44	0	0
„ light .....	15	11	3	1	15	0	0
S. races, dark .....	12	3	0	9	10	2	0
„ light .....	41	0	1	40	22	13	6

than in the light colour type, and (2) much less developed in the northern than in the southern races, I conclude that the former, also in this respect, occupy a rather lower stage in the scale of evolution\*.

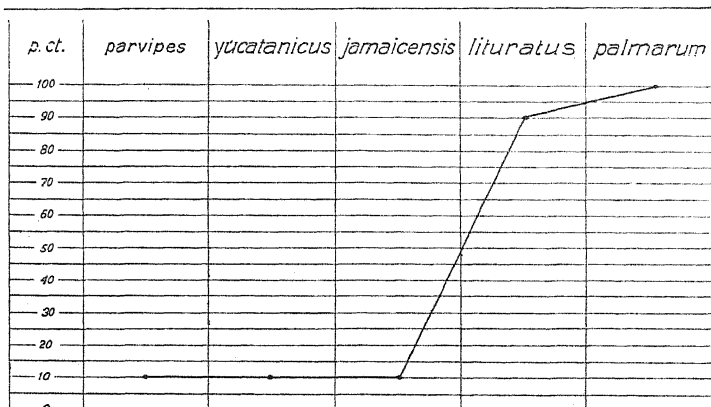


Diagram showing the percentage of individuals, in some races of *Artibeus jamaicensis*, in which the supraorbital stripes are distinct, strong, or very strong.

*Concluding remarks on the colour.*—The facts recorded above may be briefly summed up as follows:—Adult and aged individuals are dark smoky brown on the upper side (dark extreme), or Vandyck-brown (intermediate stage), or Prout's brown (light extreme), or some shade of brown intermediate between these three. Dark colour is, in all races, more common in younger adults than in aged adults. Dark-coloured individuals are predominant in *A. j. parvipes*, *yucatanicus*, *jamaicensis*, and *aquatorialis* ("northern" races), light-coloured in *A. j. lituratus* and *palmarum* ("southern" races). Facial stripes are commoner and more strongly developed in aged individuals than in immature and young adults; commoner and more strongly developed in light-coloured than in dark-coloured individuals; commoner and stronger in the southern races than in the northern. There is a certain correlation in the development of supra- and infraorbital stripes: when the former are strong, the latter are as a rule rather well marked or, at least, not quite obsolete; when the former are rather indistinct, the latter are as a rule wanting.

\* Generally speaking, facial stripes are no doubt a very primitive feature among Vertebrates, going back, as it does, to Reptiles (and being present in a vast number of Birds). But each particular case cannot, of course, be considered only from this general point of view. As a matter of fact, the *young* individuals of *A. jamaicensis* s. lat. have, as pointed out above, the facial stripes much less developed than the adults, and we are therefore compelled to assume that this primitive feature has, for some reason or other, been lost in that type of Bat (or its predecessors) from which the living *A. jamaicensis* originated, and that now there is again a tendency to reversion to the old feature in adult individuals.



*Range*.—From S. Brazil, Paraguay, and Peru, to Central Mexico (Jalisco), including the West Indies; no indisputable record from Guiana.

*Races*.—Seven races of *Artibeus jamaicensis* are described below, viz., *A. j. parvipes*, *yucatanicus*, *jamaicensis*, and *aequatorialis*; these four, as being probably of Central American and West Indian origin, may be conveniently called the "northern" races; further, *A. j. lituratus*, *palmarum*, and *praeceps*; these three, as being probably of South American origin, may be called the "southern" races.

*Remarks*.—*A. jamaicensis* is at once distinguishable from all other species of the genus by the combination of these two characters: molars  $\frac{2}{3}$ , maxillary tooth-row 9.3–12.2 mm.; the first character excludes all species with the exception of *A. glaucus* and *watsoni*, which possess a small  $m_3$ ; the second character excludes the two latter species, *A. glaucus* and *watsoni* being very much smaller (maxillary tooth-row 6.5–7 mm.)

There is no reliable *external* character by which *A. jamaicensis*, all races taken together, can be discriminated from *A. planirostris* s. lat.; the nose-leaves, ears, wing-structure, coloration, even the dimensions, are practically identical; to the larger races of *A. jamaicensis* (*lituratus*, *palmarum*) correspond the large *A. planirostris fallax*; to the small races of *A. j. jamaicensis* (*parvipes*, *yucatanicus*, *jamaicensis*) the small races of *A. planirostris* (*planirostris*, *trinitatis*, &c.); *A. jamaicensis* might properly be described as an "*A. planirostris*" which has permanently lost  $m^3$ . Dobson's way of discriminating the two species externally—the front margin of the horseshoe free in *A. planirostris*, bound down to the muzzle in "*A. perspicillatus*" (*A. jamaicensis*)—would in 66 p. ct. of cases lead to wrong or doubtful identification.

But the matter becomes rather different when considering each race of *A. jamaicensis* separately. Brazil is inhabited by the large *A. j. lituratus*, whereas the race of *A. planirostris* occurring in the same region (*A. p. planirostris*) is considerably smaller, so that only in very rare instances is there any difficulty at all in discriminating these two forms. Guiana is inhabited by the largest race known of *A. planirostris* (*A. p. fallax*); *A. jamaicensis* is as yet not recorded with certainty from Guiana, and perhaps it has not spread to that country. In Venezuela much the same contrast obtains as in Brazil, *A. j. palmarum* being as a rule considerably larger than *A. p. planirostris*. *A. jamaicensis* has spread over the whole of the West Indies (*parvipes*, *jamaicensis*, *praeceps*); *A. planirostris* is totally absent from the West Indies proper, having spread only over the Venezuelan coast islands as far as Grenada. Only Central America and Mexico are inhabited by certain small forms of *A. jamaicensis* (*jamaicensis*, *yucatanicus*) which externally, as a rule, are so completely like the small race of *A. planirostris* (*planirostris*) living in the same region, as not to be distinguishable without an examination of the teeth.

## ARTIBEUS JAMAICENSIS PARVIPES Rehn.

1828. *Phyllostoma Jamaicense* Leach, Horsfield, Zool. Journ. iii. (April to July, 1827) pp. 238-40.—Macleay's specimens from Cuba.  
 1872. ? *Artibeus perspicillatus* (sic), C. J. Maynard, Bull. Essex Inst. iv. no. 10, p. 144 (Oct. 1872).—Key West, Florida.  
 1878. *Artibeus perspicillatus* (partim, not L.), Dobson, Cat. Chir. Brit. Mus. pp. 519-20.  
 1878. *Artibeus macleayi* Dobson (from Gray's MS.), op cit. p. 520, specimens h-k.—Cuba.—Nomen nudum.  
 1902. *Artibeus parvipes* Rehn, Proc. Ac. N. Sci. Philad. pp. 639-40 (12 Oct. 1902).—Type locality: Santiago de Cuba.

*Diagnosis.*—The smallest form of *A. jamaicensis*: zygomatic width of skull 15.5-17 mm. (average 16.1); maxillary tooth-row 9.3-10 mm. (average 9.7); forearm 54-60 mm. (average 56.8).

*General characters.*—The angular emargination between cusps 5 and 7 of  $m^2$  is generally as well marked as in any *A. planirostris*. The coloration of the fur of the upper side is generally of the dark type, but light-coloured individuals occasionally occur. The facial stripes are usually obsolete or faint.

*A. j. parvipes* and *yucatanicus*.—There is only a rather small average difference between *A. j. parvipes* and *A. j. yucatanicus*. The skull of *parvipes* is generally a trifle smaller (total length 26.9 mm., as against 27.4 mm. in *yucatanicus*) and more delicately built (zygomatic width 16.1 mm., against 16.8 mm.); the difference in the size of the teeth is infinitesimal (maxillary tooth-row 9.7 mm., against 9.9 mm.). The forearm and metacarpals of *parvipes* average 2.5 to 3 mm. shorter than in *yucatanicus*; also the phalanges, the tibia and foot average a little shorter. (See the detailed measurements, p. 264.) Being in every respect, save their average dimensions, perfectly similar, *A. j. parvipes*, and *yucatanicus* are, in many cases, practically indistinguishable, if the precise locality in which the specimens were obtained is unknown.

*A. j. parvipes* and *jamaicensis*.—Although there is no absolute difference between *A. j. parvipes* and *j. jamaicensis*, the former is as a rule easily distinguished by its smaller and slenderer skull and smaller teeth. Externally there is the same average difference in dimensions between *parvipes* and *jamaicensis* as between *parvipes* and *yucatanicus*.

*Specimens from different localities.*—There is no difference between examples from Eastern and Western Cuba.

*Supposed occurrence at Key West, Florida.*—While at Key West Island, south of Florida, in the early winter of 1870, Mr. C. J. Maynard watched several large bats flying about the city; the single specimen secured has since been lost, but a drawing made by Maynard enabled the late Dr. Harrison Allen to identify the species as "*Artibeus perspicillatus* Linné."\* The Key West bats, Maynard writes, "closely resembled in flight a species which I had seen in Northern Florida two years before." If

\* Gerrit S. Miller, Jr., Proc. Bost. Soc. N. H. vol. xxviii. no. 7, p. 214, March 1898.

the identification is correct, it appears natural to suppose that the Key West bat was *A. j. parvipes*, and that, consequently, the range of this form extends to the islets between Cuba and Florida, perhaps to peninsular Florida, the flora and fauna of the southern part of which has, as well known, a subtropical character.

*Specimens examined*.—25 specimens (9 skins) and 12 skulls, from the following localities:—

British Museum:—Cuba (4). Skulls of 3 specimens.

U.S. National Museum\*:—W. Cuba: El Guama (3); San Diego de los Baños (5); Guanajay (6); Mariel (1).—E. Cuba: Baracoa (2); El Cobre (4).—9 skulls from practically all the localities enumerated.

*Range*.—Cuba, perhaps extending to Florida.

Rehn's *A. parvipes*, 1902.—Stated to differ from the Jamaican *A. jamaicensis* "in the smaller forearm and tibia, and the narrower and lighter built foot"; forearm on average "53.7 mm." (in *jamaicensis* "58.3 mm."), tibia "20.8 mm." (*jamaicensis* "21.9 mm."), foot in the type "14 mm." (in a *jamaicensis* "15 mm."). "The second upper premolar is broader and with a heavier internal shoulder, the teeth being actually broader than [in] *jamaicensis*, though the latter possesses a slightly larger skull."

As to the external characters given by Rehn, it must be said,—first, that there is no definite line of separation between the Cuban *A. parvipes* and the Jamaican *A. j. jamaicensis*: I have seen examples of *jamaicensis* with the forearm only 57 mm. long, and examples of *parvipes* with the forearm 60 mm.; in *jamaicensis* the lower leg is occasionally only 22 mm., in *parvipes* sometimes 23 mm.; in some *jamaicensis* the foot measures only 15.2 mm. in length, in some *parvipes* as much as 16.8 mm. Second, the average measurements calculated by Rehn from six *parvipes* and six *jamaicensis* give a somewhat exaggerated idea of the difference in size between the two races; compare the table of measurements, p. 284. Third, since especial stress was laid by Rehn on the smaller foot in *parvipes* (see his paper), it may be well to emphasise that this is perhaps the least conspicuous of the external differences; the average difference in this respect between the two forms is so small (0.7 mm.), and the actual measurements so frequently overlapping each other, that it would only in a small minority of cases be possible to distinguish the two forms by the size of the foot; the smaller foot in *parvipes* is simply a consequence of the smaller size of the animal; a closer study of the table of measurements (p. 284) will show that *proportionately* the foot of *parvipes* is precisely of the same size as in *jamaicensis*.—The dental difference mentioned by Rehn must either have been derived from an individual aberration in the specimen examined by him,

\* U.S. N. M. nos. 103621-22, 103627, 103631, 103640, 103643, 103670, 103692-95, 103725-26, 103733-34, 113758, 113761, 113823, 113834-36.

or it must be a mistake; as a matter of fact, the structure of the teeth in *parvipes* is exactly as in *jamaicensis*, but the size of the teeth on an average slightly smaller; and the heel of  $p^1$  is, as might be expected from this, not larger, but on average a trifle smaller than in *jamaicensis*.

#### ARTIBEUS JAMAICENSIS YUCATANICUS J. A. Allen.

1888. *Artibeus perspicillatus* (partim, not L.) Thomas, P. Z. S. p. 129 (21 Feb. 1888).—Cozumel Island (Yucatan).

1897. *Artibeus perspicillatus* (partim, not L.) J. A. Allen & Chapman, Bull. Am. Mus. N. H. ix. Art. i. pp. 3-5 (23 Feb. 1897).—Yucatan.

1904. *Artibeus yucatanicus* J. A. Allen, Bull. Am. Mus. N. H. xx. Art. 20, pp. 232-33 (29 June, 1904).—Type locality: Chichen Itza (Yucatan).

*Diagnosis*.—Similar to *A. j. parvipes*, but skull and external dimensions averaging a little larger. Zygomatic width of skull 16.3-17.2 mm. (average 16.8); maxillary tooth-row 9.7-10.2 mm. (average 9.9); forearm 56-61 mm. (average 59.6).

*General characters*.—The angular emargination between cusps 5 and 7 of  $m^2$  is usually as well marked as in any *A. planirostris*, but individuals occur in which it is distinctly reduced in size. The coloration of the fur of the upper side is generally of the dark type, but light-coloured examples are not rare, especially among individuals with somewhat worn teeth. The facial stripes are usually obsolete or faint.

*A. j. yucatanicus* and *parvipes*.—The skull of *A. j. yucatanicus* is generally a trifle larger (total length 27.4, as against 26.9 mm. in *parvipes*) and, especially, broader (zygomatic width 13.8 mm., against 16.1 mm.); the difference in the size of the teeth is infinitesimal. The forearm and metacarpals of *yucatanicus* average 2.5 to 3 mm. longer than in *parvipes*; also the phalanges, tibia, and foot average a little longer. See the detailed measurements, p. 264.—The two races come so extremely close to each other, and are practically so difficult to discriminate that, were it not for their different habitat, they ought not to be kept separate.

*A. j. yucatanicus* and *jamaicensis*.—*A. j. yucatanicus* forms a transition between the Cuban *A. j. parvipes* and the Central American (and Mexican, and West Indian) *A. j. jamaicensis*. Externally *yucatanicus* is indistinguishable from *jamaicensis*, there being not even an average difference in size; but in the size of the skull and teeth it is decidedly nearer to *parvipes* than to *jamaicensis*.

*Specimens examined*.—14 specimens (7 skins) and 11 skulls, from the following localities:—

British Museum:—N. Yucatan (1); Cozumel I. (1).—Skulls of both specimens.

U.S. National Museum\*:—Yucatan (4); Merida, Yucatan (1); Progreso, Yucatan (3); Chichen Itza, Yucatan (3); Belize (1).—9 skulls, from all the localities enumerated.

\* U.S. N. M. nos. 11445 (37547), 108153-55, 108489-91, 143119-22.

*Range*.—Yucatan, including the coast islands. The only specimens examined from Belize is referable to *A. j. yucatanicus*. Certain specimens from Campeche come very near to this race.

J. A. Allen's *A. yucatanicus*, 1904.—In 1897 (*l. s. c.*), Allen and Chapman recorded four specimens of "*Artibeus perspicillatus*" (*A. jamaicensis* Leach; *A. carpolegus* Gosse) from Chichen Itza, Yucatan. In 1904 (*l. s. c.*), Allen selected one of these examples as the type of a new species, *A. yucatanicus*. In size and colour, he writes, it resembles "the West Indian forms of the genus, especially *A. parvipes* of Cuba, from which it is not readily distinguishable"; "four skulls of *A. parvipes* measure the same [*viz.* 27 mm.] in total length, but a little less in zygomatic width." Allen does not enter into further details as to the differential characters of the new species. (The forearm measures, according to Allen, 55 mm., the third metacarpal 57 mm.; the latter must, of course, be a misprint, if the former is correct.)

*Measurements of A. j. parvipes and yucatanicus.*

	<i>A. j. parvipes.</i> 25 adults, 12 skulls.			<i>A. j. yucatanicus.</i> 14 adults, 12 skulls.		
	MIN.	MAX.	MED.	MIN.	MAX.	MED.
Skull, total length, to front of c...	26	27.3	26.9	26.2	28.3	27.4
" mastoid width	14	15	14.4	14.2	15	14.6
" width of brain-case	11.8	12.8	12.1	11.7	12.8	12.3
" zygomatic width	15.5	17	16.1	16.3	17.2	16.8
" maxillary width, across m <sup>1</sup>	11.2	12.3	11.8	11.5	12.8	12.1
" across cingula of canines	7.2	8	7.5	7.3	8	7.7
Mandible, to front of inc.	18	19	18.4	18	19.7	18.9
Upper teeth, c-m <sup>2</sup>	9.3	10	9.7	9.7	10.2	9.9
Lower teeth, c-m <sub>3</sub>	10.2	10.7	10.4	10.2	11	10.7
Ear-conch, length, inner margin	13.2	15.5	14.4	14	14.5	
" length, outer margin	19	21.5	20.3	19.8	21	
" width	13	15.5	14.2	13.7	13.7	
Tragus, length	6.2	7.2	6.8	6.8		
Lancet, length	8.5	10	9.3	8.5	9	
" width	6	7	6.4	7	7.5	
Horseshoe, width	6.2	8	7.3	7.5	7.8	
Forearm	54	60	56.8	56	61	59.6
Pollex	12.5	14.5	13.9	13.2	14.3	13.7
3rd metacarpal	48	55	51.3	50	55.2	53.8
III <sup>1</sup>	13.5	18	16.3	16.2	18.8	17.2
III <sup>2</sup>	24.5	29.5	27.3	26.7	30.2	28.8
III <sup>3</sup>	12.8	16.8	14.5	13.2	15.2	14.6
4th metacarpal	47.2	53.8	50.2	48.8	54.7	53
IV <sup>1</sup>	12.2	15.8	14.5	14	16.3	15.3
IV <sup>2</sup>	16.2	20.5	17.9	17.8	20.7	19
5th metacarpal	48.2	56	51.9	50	56	54.5
V <sup>1</sup>	10.7	12.2	11.3	10.8	12.8	11.7
V <sup>2</sup>	12	15	13.6	13	16	14.6
Interfemoral	10	17	14.1	14.8		
Lower leg	20.7	23	21.6	21.3	23	22.2
Foot, with claws	14	16.8	15.4	14.2	17	15.7
Calcar	5.2	7.3	6.4	5.8	6.2	

As already pointed out above, *A. j. yucatanicus* is similar to *A. j. parvipes* and *jamaicensis* in every respect but a small average difference in size; in the size of the skull and teeth it comes extremely near to the former race, in external dimensions it is indistinguishable from the latter. *A. j. yucatanicus* therefore cannot be considered a distinct species; it forms, in its characters as in its geographical habitat, a transition between the two races, and is in some cases practically inseparable from either.

#### ARTIBEUS JAMAICENSIS JAMAICENSIS Leach.

1821. *Artibeus Jamaicensis* Leach, Trans. Linn. Soc. xiii. pt. i. p. 75 (read 7 March, 1820).—Type locality: Jamaica.  
 1821. *Madatæus Lewisii* Leach, t. c. pp. 81–82.—Type locality: Jamaica.  
 1851. *Artibeus carpolegus* Gosse, A Naturalist's Sojourn in Jamaica, pp. 271, 272 (footnote), pl. vi. fig. 5.—Type locality: Jamaica.  
 1861. *Artibeus perspicillatus* (not L.) Tomes, P. Z. S. (26 Feb. 1861) p. 64.—Jamaica (W. Osburn's specimens).  
 1865. *Artibeus carpolegus* Gosse, W. Osburn, P. Z. S. (24 Jan. 1865) pp. 64–67.—Jamaica (habits).  
 1865. *Artibeus jamaicensis* Leach, Peters, MB. Akad. Berlin (13 July 1865), p. 356.  
 1878. *Artibeus perspicillatus* (partim, not L.) Dobson, Cat. Chir. Brit. Mus. pp. 519–20.—Jamaica, S. Domingo, Mexico, Central America (partim).  
 1889. *Dermanura eva* Cope, American Naturalist, vol. xxiii. no. 266, p. 130 (Feb. 1889).—Type locality: St. Martins, W.I.  
 1890. *Artibeus coryi* J. A. Allen, Bull. Am. Mus. N. H. iii. no. i. p. 173, cf. pp. 171–72 (14 Nov. 1890).—Type locality: St. Andrew's I.  
 1896. *Artibeus perspicillatus* (not L.) Elliot, Field Col. Mus., Zool. Ser. vol. i. no. 3, p. 82 (May 1896).—San Domingo, W.I.  
 1902. *Artibeus intermedius* J. A. Allen (partim), Outram Bangs, Bull. Mus. Comp. Zool. xxxix. no. 2, p. 50 (April 1902).—Bogava, Chiriqui (the smaller specimens).  
 1904. *Artibeus insularis* J. A. Allen, Bull. Am. Mus. N. H. xx. Art. 20, pp. 231–32 (29 June, 1904).—Type locality: St. Kitts, W.I.

*Diagnosis*.—Similar to *A. j. yucatanicus*, but the skull, on average, a little larger and more heavily built, the teeth a little larger. Zygomatic width 16.2–18.2 mm. (average 17.4); maxillary tooth-row 9.8–11 mm. (average 10.3); forearm 56.5–65 mm. (average 60.1).

*General characters*.—The angular emargination between cusps 5 and 7 of  $m^2$  (reminiscent of the missing  $m^3$ ) is in 75 p. ct. of the large number of skulls examined as strongly pronounced as in any of those species (*A. concolor*, *planirostris*, *hirsutus*) which possess an  $m^3$ ; in only about 20 p. ct. it is distinctly reduced in size, and in 4 or 5 p. ct. it has almost disappeared. The coloration of the fur of the upper side of the body is generally of the dark type, even in individuals with somewhat worn teeth; specimens of the light colour type are rare among full-grown individuals with unworn teeth, become rather more common among those with somewhat worn teeth, and appear to be predominant among those with much worn teeth. The supraorbital stripes are almost always undeveloped or faint, rarely distinct, never (so far as the available material goes) very strong; the infraorbital stripes are always undeveloped or faint.

*A. j. jamaicensis and closely allied forms*.—Neither in structure

nor in colour is there any difference between *A. j. jamaicensis* and its closest allies, *A. j. yucatanicus* and *parvipes*; but there is a distinct average difference in size, small though it is. The details have been briefly commented upon in the descriptions of the two latter races (pp. 261 and 263), and are expressed in the table of measurements, p. 284.

*Specimens from different localities.*—*A. j. jamaicensis* covers a much wider area than the two foregoing races (*yucatanicus*, *parvipes*). It is distributed over the whole of Central America, including the outlying small islands (St. Andrew's, Old Providence), and S. Mexico, at least as far as Morelos; further, over Jamaica, San Domingo, Porto Rico, and the smaller islands east of this latter, at least as far as St. Kitts. I have carefully compared specimens (skulls, spirit-specimens, skins) from all these places, and am unable to find the slightest indication of a difference. It is very easy, indeed, to contrast a smaller-skulled (smaller-toothed) individual from one place with a larger-skulled (larger-toothed) from another continental place or another island, a smaller-winged with a larger-winged, a darker-coloured with a lighter-coloured, or a specimen with short with a specimen with long interfemoral. When material is scarce, differences of this kind may very easily lead (and, in fact, have led) to separation of different forms or even species; but whenever the various localities have been represented by a sufficiently extensive series in the material examined by me (as has been the case with Central America, S. Mexico, Jamaica, Porto Rico, St. Andrew's Island, Old Providence Island), I have found the range of individual variation to be precisely the same within each particular locality; there is no difference whatever in structure nor in coloration, and there is not even an average difference in size.

In the comparative table of measurements below (p. 269) the specimens have been arranged under seven headings, viz., Central America (Panama, Nicaragua, Honduras, Ruatan I., Guatemala), S. Mexico (Campeche, Chiapas, Tehuantepec, Oaxaca, Vera Cruz, Morelos, "Mexico"), Jamaica, Porto Rico, San Domingo, St. Kitts, St. Andrew's and Old Providence Islands. From each of these seven areas are given the minimum, maximum, and average measurements (the latter not for the few available specimens from San Domingo and St. Kitts). The table shows the complete accordance in the size of individuals from these seven areas.

To prevent wrong identification it is important to emphasise that *Central America is inhabited by two races*, which ought not to be (but hitherto have always been) confused, viz. the smaller (truly indigenous) *A. j. jamaicensis* and the larger *A. j. palmarum* (an immigrant from south).

*Specimens examined.*—105 specimens (58 skins) and 76 skulls, from the following localities:—

British Museum:—Nicaragua: Corinto (1).—Honduras: Half-Moon Key (1); Ruatan Island (5).—Guatemala: Dueñas (1).—"Mexico" (1).—St. Andrew's Island (3).—Jamaica (17).—San

Domingo (2).—Porto Rico (2).—29 skulls, from all the localities enumerated.

U.S. National Museum\*:—Panama: Colon (1).—Nicaragua: Greytown (1); Escondido River, 50 miles from Bluefields (1).—Guatemala: Peten (1).—Campeche: Apazote, near Johallun (4).—Chiapas: Palenque (7); San Bartolomé (4); San Vicente (4).—Tehuantepec (1).—Oaxaca: Santo Domingo (4).—Vera Cruz: Tuxtla (1); Mirador (1).—Morelos (3).—Old Providence Island (5).—Jamaica, various places (9).—San Domingo (1).—Porto Rico, various places (23).—St. Kitts Island (1).—47 skulls, from all the localities enumerated.

*Range*.—Central America and S. Mexico, as far north as Morelos, and exclusive of Yucatan; St. Andrew's and Old Providence Islands; Jamaica, San Domingo, Porto Rico, as far east as St. Kitts.

Leach's *A. jamaicensis*, 1821.—The probable type, the skin (unregistered) of an adult individual from Jamaica ("a" in Dobson's Catalogue, p. 520), with skull ("q<sup>1</sup>"), is in the British Museum.

Leach's *Myotis lewisii*, 1821.—The type, in the British Museum (skin, with skull; unregistered; "b" in Dobson's Catalogue, p. 520), is a very young *A. j. jamaicensis*, sent from Jamaica by W. Lewis. The peculiarities which led Leach to regard it as a distinct species (and genus) are due to the immaturity of the individual.

Gosse's *A. carpolegus*, 1851.—Based on a ♂ ad., obtained by Gosse at Content, Jamaica, preserved in alcohol; Brit. Mus. no. 47.12.27.13. Indistinguishable from Leach's *A. jamaicensis*. The Bat now called *Ariteus achradophilus* was described by Gosse under three names:—*A. jamaicensis* Leach (of which he had only Horsfield's description in Zool. Journ. iii. (1828) p. 238 for comparison), *A. achradophilus* Gosse, and *A. sulphureus* Gosse (light phase); the true *A. jamaicensis* Leach he described under a new name, *A. carpolegus* Gosse.

Cope's *Dermanura eva*, 1889.—Founded on two adult males, from the island of St. Martins, West Indies, now in the collection of the Academy of Natural Sciences, Philadelphia. They were stated by Cope to have  $\frac{2}{3}$  molars only, and therefore referred by him to the "genus" *Dermanura*; the rest of the description (lip tubercles, nose-leaves, ears, interfemoral, fur, colour, dimensions) is that of an ordinary *A. j. jamaicensis*; forearm 59, tibia 21, foot 17 mm.; no description nor measurements of the skull.—The types were re-examined by Rehn, in 1900 †,

\* U.S. N. M. nos.:—8671 (9387), 11187, 13220 (37912), 14305, 14410, 14412-13, 14415, 14753 (37811), 16332 (23360), 53063, 64482-83, 70431, 70453, 73225, 73265, 86280, 86282-84, 86310-15, 86349, 86352-53, 86392-93, 96182, 100192, 100199, 100202, 100204, 102458, 108025, 108232, 108234, 108236, 108238-39, 108242, 110939, 112122, 112124, 112131-34, 112136-37, 113442, 113927-29, 114038, 122430-32, 133042-45, 133050, 133052-54, 147135-36.

† James A. G. Rehn, "Notes on Chiroptera," Proc. Ac. Nat. Sci. Philad., Dec. 1900, pp. 758-59 (9 Feb. 1901).



who, on extracting the skull of one of the specimens, found it to have  $\frac{2}{3}$  molars; thus the only difference between *D. eva* and *A. j. jamaicensis* to be derived from Cope's description proves to be imaginary. According to Rehn, the skull measures 27.6 mm. (total length), the zygomatic width 17, the forearm 62, tibia 24, foot 14, measurements which fall completely within the limits of *A. j. jamaicensis*. Cope found the interfemoral "notched to a line opposite the middle of the tibia"; Rehn writes that it is "of much greater expanse than either [in] *perspicillatus* or *planirostris*," and this is evidently his only reason to keep "*D. eva*" separate; but there is in this respect a very great individual variation: in 7 spirit-specimens of *A. j. jamaicensis* from Jamaica the length of the interfemoral, measured in the middle line, varies between 11.2 and 19 mm.; a similar variation is found in specimens of *A. j. jamaicensis* from other places, as well as in other races of the species. *A. j. jamaicensis* occurs west of St. Martins (Porto Rico) and east of St. Martins (St. Kitts), so that also from this point of view there is not much probability that St. Martins individuals differ from the true *A. j. jamaicensis*.

J. A. Allen's *A. coryi*, 1890.—Based on a single specimen, taken on St. Andrew's Island, Caribbean Sea, Feb. 12, 1887, by one of Mr. C. B. Cory's collectors. It was described by Allen (*l. s. c.*) as a distinct species on account of its colour:—"General color above dark seal brown (brownish black), but very little lighter at the base than at the surface; no trace of white streaks on the face." Forearm "50.1 mm." (*sic*); third metacarpal "56 mm." (or "55 mm.," see p. 171 of Allen's paper).

There are three skins of "*A. coryi*" in the British Museum, from the same island as the type specimen, taken by the same collector, on the same date. Their coloration is as described by Allen, but on examination of their teeth they prove to be youngish, though full-grown, individuals (teeth perfectly unworn); this accounts sufficiently for their dark coloration, which is indistinguishable from that of youngish specimens of *A. j. jamaicensis* from Jamaica, Porto Rico, S. Mexico, &c. (and of any other race of *A. jamaicensis*, the South American forms not excluded). The absence of facial stripes is due, partly to the fact that St. Andrew's individuals belong to the northern group of races of *A. jamaicensis*, in which these stripes are generally wanting or but faintly developed; partly to the fact that the individuals obtained by Cory are young adults, in which the facial stripes are generally wanting or still more faintly indicated than in specimens of more advanced age.—Allen's measurement of the forearm, viz. 50.1 mm., is incorrect, and the explanation of the error is no doubt this: in the three British Museum specimens the proximal part of the radius has been cut away by the taxidermist; presumably the same is the case in Allen's specimen, since it is from the same collector and place; the true length of the forearm, judging from the length of the metacarpals, would be about 60 mm., as in an average *A. j. jamaicensis*.—On p. 171

*Measurements of Artibeus jamaicensis jamaicensis.*

	Central America (detailed localities see p. 266). 12 adults, 9 skulls.			S. Mexico. (detailed localities see p. 266). 27 adults, 23 skulls.			Jamaica. 21 adults, 11 skulls.			Porto Rico. 23 adults, 11 skulls.			San Domingo, St. Kitts, Old Providence Island. 8 adults, 5 skulls.		
	MIN.	MAX.	MEAN.	MIN.	MAX.	MEAN.	MIN.	MAX.	MEAN.	MIN.	MAX.	MEAN.	MIN.	MAX.	MEAN.
Skull, total length, to front of c.	27	29.2	28.3	27.8	29.2	28.1	27.7	28.8	28.2	27.8	29	28.5	27.2	29	28.2
" mastoid width	14.8	15.8	15.3	14.7	16.1	15.3	14.7	15.2	14.9	14.7	15.2	14.9	14.5	15.5	14.8
" width of brain-case	12	13	12.6	12.5	13	12.8	12	13	12.6	12	13.3	12.8	12	13	12.6
" zygomatic width	17.2	18.2	17.6	17.2	18.2	17.8	16.7	17.8	17.4	16.2	17.8	16.9	16.5	17.8	17.2
" maxillary width across m.	12.2	13.2	12.7	12	13.2	12.7	12.2	13.7	12.7	12.2	13	12.4	12.2	12.8	12.4
" across angle of canines.	7.8	8.8	8.2	7.7	9.1	8.2	7.8	8.6	8	7.8	8.3	8.1	7.7	8	7.9
Mandible, to front of inc.	18.8	20.7	19.4	19	20.2	19.6	19.2	20.2	19.5	19.2	20.2	19.7	18.8	19.8	19.3
Upper teeth, c-m <sup>2</sup>	10.8	11.7	11.2	10.7	11.5	11.1	10.7	11.5	11.1	10.7	11.8	11.1	10.5	11.2	11
Lower teeth, c-m <sup>3</sup>	13.8	15.8	14.6	14	16	15	14	15	14.7	14	15.7	14.7	14	15	14.4
Ear-conch, length, inner margin	21	22.2	21.6	19.8	22	21.7	20	22	21.2	19.7	22	20.6	19.8	20.3	20.3
" " length, outer margin	13.5	16	14.4	13.5	15.5	14.5	13.8	15	14.3	13.5	16	14.2	13.5	13.8	13.7
" " width	6	7.2	6.7	6.5	7.3	6.9	6.2	7.7	6.9	6.5	7.5	7.1	6.5	7.5	7.2
Tragus, length	8.7	10.8	9.6	9	10.8	9.7	9	10	9.6	9	10.5	9.7	9	10.5	9
Lancet, length	6.2	7	6.7	6	7.4	6.7	6.8	7.8	7.2	6	7.5	6.7	6	7.5	6.6
" width	6.5	8.2	7.6	7.5	8.5	8.1	6.8	8	7.6	7	7.8	7.3	7.5	8.5	8
Horseshoe, width	56.5	66	60	58.5	65	61.1	57	63.5	59.8	57	63	59.7	58	60	59.1
Forearm	132	157	142	132	155	145	135	153	142	13	15	14.1	13	15	13.9
Forearm	51.5	58.2	53.9	51.2	61	55	50	56	53.3	50	56	53.2	53	55	53.8
3rd metacarpal	19	19.4	19	17.4	20	17.7	15.8	17.8	16.9	16	18	16.8	16.2	17	16.8
III <sup>1</sup>	26	32	29.1	26.2	32.8	29.6	26.8	31.8	28.5	26.2	30.7	28.3	26.5	29.2	28
III <sup>2</sup>	15	17.7	16	14	17.5	15.9	14	16.5	15.4	13.7	16.2	14.7	15	16	15.8
III <sup>3</sup>	50	57.2	53.1	49.5	59.8	54.1	49.5	54.8	52.6	49	54	52.1	51.7	54.5	52.5
4th metacarpal	14	16.7	15.4	13.8	17.2	15.7	14	16	15	14	16	14.7	14.7	16.2	15.4
IV <sup>1</sup>	16	21.5	19.1	17	20.7	19.4	17.5	20.7	19.1	17	20	18.7	17.7	20	18.7
IV <sup>2</sup>	52.3	58.5	54.8	51	62.5	55.7	52	57.5	54.6	51.7	56.5	54.1	53	56	54
5th metacarpal	11	13.7	12.2	10.8	13.8	12.2	11	12.5	11.7	11	12.8	11.7	11.8	12.8	11.8
V <sup>1</sup>	12.8	16.2	14.7	13.2	17	15	13.5	15.3	14.3	12.7	15.2	13.9	13.7	15	14.3
V <sup>2</sup>	11	18.2	15.7	13	17.8	15.3	11.2	19	15.8	12.5	16	14.7	14.7	17	16
Interfenoral	21	24	22.3	21.2	24.2	22.8	22	24	22.9	21.7	24	22.8	22.5	24	22.5
Lower leg	15.7	16.8	16.3	14.2	17.2	16.1	15.2	17	16.1	15	17.2	16	15	15.7	16.2
Foot, with claws	5.7	7	6.2	5.2	7.8	6.4	6	7.5	6.5	6	7.7	6.6	6.2	6.7	6.5
Calcaneus															

of the paper quoted above, Allen writes that "*A. coryi*" "differs greatly from all others [all other forms of the "*perspicillatus*" section] in colour and in the distribution of the fur on the forearms, which on the dorsal surface extends densely in a broad band along the humeri and over about the proximal third of the forearm bones." There must be some mistake here: the distribution of the fur on the forearm in *St. Andrew's* specimens is as described by Allen, but so it is also in all other individuals of *A. j. jamaicensis*, from any place, I have seen, and, in fact, in all other races of *A. j. jamaicensis*.

J. A. Allen's *A. insularis*, 1904.—Type locality: St. Kitts, West Indies. "Based on a single alcoholic specimen, a very old male, in excellent preservation, but with the skull badly broken. In external measurements it agrees very well with *A. jamaicensis*, . . . . . The skull, however, in *A. insularis* is much larger than in *A. jamaicensis*, the width across  $m^2$ - $m^2$  being 1 mm. (about one tenth) greater, and the rostrum at the base of the canines is also a millimetre wider, or about one eighth wider. This indicates a much larger and more massive skull than in *A. jamaicensis*, while the external measurements are about the same." "Dorsal surface pale reddish brown, paler below; membranes pale brown; no head stripes." Width of skull across  $m^2$  13; width at base of canines 8.6; upper tooth-row ( $c$ - $m^2$ ) 11; lower tooth-row 11; forearm 61; third metacarpal 58 mm.

The specimen described by Allen is, in certain respects, a little above the average size, but all the measurements recorded fall quite within the limits of individual variation reached by *A. j. jamaicensis*; the specimen is matched, or surpassed, by a good number of *A. j. jamaicensis* from many different places. The measurement of the lower tooth-row must have been taken from the front of the canine to the back of  $m_2$ , not to the back of  $m_3$  (or it would be greater than, not the same as, that of the upper row, from  $c$  to  $m^2$ ). The measurement of the second phalanx of the third digit, stated to be 40 mm., is obviously wrong. The light colour of the fur is due to the specimen being, as said by Allen, "very old." The absence of facial stripes is a common feature in *A. j. jamaicensis*.—An example from St. Kitts examined by me (U.S. N. M. no. 110939) is in every respect (external characters, skull, teeth) indistinguishable from *A. j. jamaicensis*; it shows no approximation to *A. j. preceps*.

#### ARTIBEUS JAMAICENSIS EQUATORIALIS, K. And.

1906. *Artibeus jamaicensis equatorialis* Knud Andersen, Ann. & Mag. N. H. (7) xviii. p. 421 (1 Dec. 1906).—Type locality: Zaruma, S. Ecuador.

*Diagnosis*.—Similar to *A. j. jamaicensis*, but skull, teeth, and external dimensions averaging somewhat larger. Total length of skull, to front of canines, 28.8–30 mm. (average 29.7); zygomatic width 18.2–18.5 mm. (average 18.3); maxillary tooth-row 10.8–11.2 mm. (11.0); forearm 60.8–66 mm. (62.9).

*General characters.*—The angular emargination in the posterior margin of  $m^2$ , between cusps 5 and 7, is generally as well marked as in any *A. planirostris*, sometimes reduced in size or almost obliterated. The coloration of the fur is, in the only adult individual available with quite unworn teeth, of the dark type, in more aged specimens often light. The supraorbital stripes are sometimes well marked; the infraorbital stripes in all specimens examined undeveloped or faint.

*A. j. æquatorialis* and *jamaicensis*.—The skull of *A. j. æquatorialis* averages larger, and especially broader, than in *A. j. jamaicensis*, the zygomatic width being 18·3 mm., as against 17·4 in *jamaicensis*, the maxillary width (externally, across  $m^1$ ) 13·6, against 12·6, the width across the cingulum of the upper canines 8·9, against 8·1; the teeth are a little larger, the maxillary tooth-row being 11·0 mm., against 10·3. In all these respects *A. j. æquatorialis* is as much larger than *A. j. jamaicensis* as this

*Measurements of A. j. jamaicensis and æquatorialis.*

	<i>A. j. jamaicensis.</i> 95 adults, 65 skulls.			<i>A. j. æquatorialis.</i> 7 adults, 6 skulls.		
	MIN.	MAX.	MED.	MIN.	MAX.	MED.
	mm.	mm.	mm.	mm.	mm.	mm.
Skull, total length, to front of c ...	27	29·2	28·3	28·8	30	29·7
„ mastoid width .....	14·2	16·1	15·1	15·2	16·2	15·8
„ width of brain-case .....	12	13·3	12·7	12·8	13·5	13·1
„ zygomatic width .....	16·2	18·2	17·4	18·2	18·5	18·3
„ maxillary width across $m^1$ .....	12	13·7	12·6	13·3	14	13·6
„ across cingula of canines ...	7·7	9·1	8·1	8·3	9·2	8·9
Mandible, to front of inc. ....	18·8	20·7	19·5	20·3	21·5	21·1
Upper teeth, c- $m^2$ .....	9·8	11	10·3	10·8	11·2	11
Lower teeth, c- $m_2$ .....	10·5	11·8	11·1	11·8	12·6	12·1
Ear-couch, length, inner margin ..	13·8	16	14·8	15	15·8	
„ length, outer margin .....	19·7	22·2	21·3	22·7	23·5	
„ width .....	13·5	16	14·3	14·8	15·7	
Tragus, length .....	6	7·7	7	7·2	7·5	
Lancet, length .....	8·2	10·8	9·6	9·8	11	
„ width .....	6	7·8	6·8	7·4	7·5	
Horseshoe, width .....	6·5	8·5	7·6	8·5	9	
Forearm .....	56·5	65	60·1	60·8	66	62·9
Pollex .....	13	15·7	14·2	14	15·2	14·4
3rd metacarpal .....	50	61	53·7	54·5	59·5	56·9
III <sup>1</sup> .....	15·8	20	17·3	17·7	19·3	18·4
III <sup>2</sup> .....	26	32·8	28·8	30·3	33	30·9
III <sup>3</sup> .....	13·7	17·8	15·5	16·2	17·8	16·9
4th metacarpal .....	49	59·8	52·9	53·7	57·2	55·4
IV <sup>1</sup> .....	13·8	17·2	15·2	15·8	17·2	16·6
IV <sup>2</sup> .....	16	21·5	19	19·8	22	19·9
5th metacarpal .....	51	62·5	54·7	54·5	59·7	57·2
V <sup>1</sup> .....	10·8	13·8	11·9	12	13·2	12·8
V <sup>2</sup> .....	12·7	17	14·5	14·2	17·2	15·4
Interfemoral .....	11	19	15·5	17·5	18·5	
Lower leg .....	21	24·2	22·8	22·8	26	24·1
Foot, with claws .....	14·2	17·7	16·1	16	17	16·8
Calcar .....	5·2	7·8	6·5	7	8	7·2

latter is larger than *A. j. parvipes*. The forearm and metacarpals average 2.5 to 3 mm. longer than in *A. j. jamaicensis*; thus, also in external dimensions it bears much the same relation to *A. j. jamaicensis* and *yucatanicus*, as these latter to *A. j. parvipes*. For further details see the tables of measurements pp. 271 and 284.

Geographically there is, in the series of *jamaicensis* and *aequatorialis* available, a break between the former and the latter. I have had no specimen of *jamaicensis* from any place south of Panama (Colon), and none of *aequatorialis* north of S. Colombia (Cali); but there cannot be much doubt that further investigations will fill up this gap, so that there, also geographically, will prove to be a perfect transition between *A. j. jamaicensis* and its southern representative, *A. j. aequatorialis*.

*Specimens examined*.—9 specimens (8 skins) and 8 skulls, from the following localities:—

British Museum:—Zaruma, S. Ecuador (6). Cali, S. Colombia (2).—7 skulls, representing both localities.

U.S. National Museum\*:—Corondelet, N. Ecuador (1, with skull).

*Range*.—As yet known only from the region between Zaruma, S. Ecuador, and Cali, S. Colombia.

#### ARTIBEUS JAMAICENSIS LITURATUS Licht.

1801. *Chauve-souris première* ou *Chauve-souris obscure et rayée*, Azara, Essais sur l'histoire naturelle des Quadrupèdes de la province du Paraguay, ii. pp. 269-70.—Paraguay.
1815. *Phyllostomus lituratus* Illiger, Abh. Akad. Berlin, 28 Feb. 1811 (issued 1815), p. 109.—Nomen nudum.
1823. *Phyllostomus lituratus* Ill., Lichtenstein, Verz. Doubl. Berlin. Mus. p. 3.—Brazil.
1826. ? *Phyllostoma superciliatum* Wied, Beitr. Naturg. Bras. ii. pp. 200-202.—Type locality: Rio de Janeiro.
1830. *Phyllostoma superciliatum* Wied, Rengger, Naturg. Säugeth. Paraguay, pp. 74-75.—Paraguay.
1840. *Phyllostoma perspicillatum* (partim, not L.) Wagner, Schreber's Säugethiere, Suppl. i. pp. 403-5.—Spix's type of "*Ph. planirostre*" compared with Spix's specimens of *A. j. lituratus*.
1878. *Artibeus perspicillatus* (partim, not L.) Dobson, Cat. Chir. Brit. Mus. pp. 519-20.—Brazil, Bolivia, Colombia.
1878. *Artibeus grandis* Dobson (from Gray's MS.), op. cit. p. 250, specimen  $\lambda^1$ .—Nomen nudum.
1892. *Artobius perspicillatus* (not L.) Winge, Jordfundne og nulevende Flagermus fra Lagoa Santa, Minas Geraes, Brasilien; E. Museo Lundii, ii. pt. 1, p. 10, pl. i. fig. 13.—Minas Geraes.
1900. *Artibeus lituratus* Licht., Thomas, Ann. Mus. Civ. Genova (2) xx. p. 547 (4 July, 1900).—Parana.
1901. *Artibeus jamaicensis* Leach, Thomas, Ann. & Mag. N. H. (7) viii. p. 192 (Sept. 1901).—Para.
1901. *Artibeus lituratus* Licht., Thomas, Ann. & Mag. N. H. (7) viii. p. 441 (Nov. 1901).—Paraguay.
1904. *Artibeus rusbyi* J. A. Allen, Bull. Am. Mus. N. H. xx. Art. 20, pp. 230-31 (29 June, 1904).—Type locality: Yungas, "Peru" (probably a slip for Bolivia).

*Diagnosis*.—In all essential respects similar to *A. j. jamaicensis*, but considerably larger. Total length of skull 30.5-34 mm.

\* U.S. N. M. no. 113363.

(average 32.2); zygomatic width 18.8–20.2 mm. (average 19.4); maxillary tooth-row 10.7–12.2 mm. (11.7); forearm 64–73.5 mm. (70.2).

*General characters.*—This is the first of the three very closely related southern races of *A. jamaicensis* described in this paper. The southern group (*A. j. lituratus*, *palmarum*, *princeps*) differs from the northern (*A. j. parvipes*, *yucatanicus*, *jamaicensis*, *aequatorialis*) chiefly in the following points:—

The angular notch in the posterior margin of  $m^2$ , between its cusps 5 and 7, is rather rarely as well marked as in *A. planirostris*; generally (in about 90 p. ct. of 68 skulls examined) it is either noticeably reduced or completely filled up; in the latter case the bulk of  $m^2$  has been increased by an area more or less corresponding to that of the missing  $m^3$ . By advancing age the sagittal crest of the skull is produced considerably forward, the supraorbital ridges directed almost straightly outward, the post-orbital and anteorbital processes conspicuously developed,—as described in detail and figured on p. 248. The dimensions are, generally, in every respect larger, sometimes (especially in *A. j. lituratus* and *palmarum*) considerably larger. The colour in full-grown individuals with unworn or practically unworn teeth is, most often, of the dark type, rather often, however, light; at a higher age the majority of individuals are light-coloured. The supraorbital stripes are, as a rule, well marked, often very strong, rather rarely faint or obsolete; the infraorbital stripes not rarely well developed.

*A. j. lituratus*, *jamaicensis*, and *aequatorialis*.—There is very rarely any difficulty in discriminating *A. j. lituratus* from *A. j. jamaicensis*. The skull averages almost 4 mm. (14 p. ct.) longer, and 1.5–2 mm. (14 p. ct.) broader, the tooth-rows 1.4–1.7 mm. (about 14 p. ct.) longer than in *A. j. jamaicensis*; the forearm and metacarpals average nearly 10 mm. (16–18 p. ct.) longer. Even the very smallest individuals of *A. j. lituratus* have, almost always, the skull and teeth in some direction or other more heavily built than in the largest individuals of *A. j. jamaicensis*. When, further, it is taken into consideration that there is absolutely no overlapping of the geographical areas occupied by these two races, a confusion becomes practically impossible.

*A. j. aequatorialis* is generally a little larger than *A. j. jamaicensis*, and, consequently, comes a little nearer to *A. j. lituratus* in size; but the average difference between *aequatorialis* and *lituratus* is still very great, the absolute difference as a rule well marked. *A. j. lituratus* extends into the area inhabited by *A. j. aequatorialis*, but individuals which cannot be referred with certainty to either the one or the other form seem, even in the region common to both, to be very rare.

*A. j. lituratus* cannot be separated as a distinct species. First, individuals do occur, though rarely, that cannot, by their characters alone (*i. e.* apart from their habitat), be discriminated with certainty from some individuals of *A. j. aequatorialis* and *jamaicensis*;

second, *A. j. palmarum* and *praeceps* completely overbridge the gap (if gap it be called) between *lituratus* and *jamaicensis*.

On the difference between *A. j. lituratus* and *palmarum* see this latter form.

*Specimens examined*.—54 specimens (42 skins) and 42 skulls, from the following localities:—

British Museum:—Paraguay: Sapucay (7); Asuncion (1).—Sta. Catharina (1).—Parana: Morretes, Serra do Mar, 10 m. (5); Palmeira (1).—S. Paulo: Cruzeiro, 530 m. (5).—Minas Geraes: Sete Lagoas (1).—Bahia; Samarão, 300 m. (2).—Para (2).—“Brazil” or uncertain localities (6).—Colombia: Cali (4); Bogota region, various places (4); “Colombia” (2).—36 skulls, from all the localities enumerated.

U.S. National Museum\*: Paraguay: Sapucay and Villa Rica (9).—Sta. Catharina (1).—N. Ecuador: Pambilar (1).—S. Colombia: Cali (2).—6 skulls, representing all these localities.

*Range*.—Paraguay, Brazil, Ecuador, S. and Central Colombia.

Linné's *Vespertilio perspicillatus*, 1758 †.—As pointed out by Oldfield Thomas in 1892 and 1901 ‡, Linné's *V. perspicillatus* was based primarily on Seba's “*Vespertilio Americanus vulgaris*” §, which is the bat commonly called *Carollia brevicauda*.

Schreber's *V. perspicillatus* ¶ is probably also *Carollia*; the presence of a tail (“ganz in die Schwanzhaut eingeschlossen, und so kurz, dass er noch nicht an die Hälfte ihrer Mitte reicht”) excludes at all events the genus *Artibeus*.

Geoffroy's *Phyllostoma perspicillatum* ¶¶ from Guiana is either *A. planirostris* or one of the large races of *A. jamaicensis*, which of these two species cannot be decided from the description. The species commonly brought by collectors from Guiana is *A. planirostris*; if Geoffroy's bat is an *A. jamaicensis*, it is the only record known to me of this species from Guiana. The figure has the front of the horseshoe completely confluent with the integument of the muzzle.

Wagner's description of “*Phyllostoma perspicillatum*” (1840, *l. s. c.*) was based on Spix's type of *Ph. planirostre* and two specimens of *A. jamaicensis lituratus*, all of which had been obtained by Spix at Bahia and were by Wagner taken to be “types” of *Ph. planirostre*; see pp. 238–239 of this paper.

Dobson's *Artibeus perspicillatus* (1878, *l. s. c.*) is the species here called *A. jamaicensis*.

Azara's *Chauve-souris première*, 1801.—In 1901 \*\*, Oldfield

\* U.S. N. M. nos. 105587, 105625–26, 113362, 113364–65, 115065, 121445, 121447, 121466–67, 121469, 122139.

† Syst. Nat. ed. 10, i. p. 31 (1758).

‡ Thomas, P. Z. S. 1892, p. 315; Ann. & Mag. N. H. (7) viii. p. 192 (Sept. 1901).

§ Seba, Thesaurus, i. p. 90, pl. lv. fig. 2 (1734).

¶ Schreber, Säugethiere, i. pp. 160–61, pl. xlv. A (1775).

¶¶ Geoffroy, Ann. Mus. d'Hist. Nat. xv. pp. 176–77, 186, pl. xi, upper right figure (1810).

\*\* Thomas, Ann. & Mag. N. H. (7) viii. pp. 441, 443 (Nov. 1901).

Thomas called attention to the identity of Azara's "Chauve-souris première ou Chauve-souris obscure et rayée" with Lichtenstein's *Phyllostomus lituratus*. The essence of Azara's description (Azara did not see this bat, but copied the description from manuscript notes by Noséda) is this: the "Chauve-souris première" is a bat, (1) of large size (length 110 mm., expanse 525 mm.), (2) with no tail, (3) with a white stripe from the nose to the ear, and (4) inhabiting Paraguay. *A. j. lituratus* is the only tailless bat of this size known from Paraguay.

Lichtenstein's *Phyllostomus lituratus*, 1823.—Based, without description, on Azara's "Chauve souris obscure et rayée." As the identity of Azara's bat is unquestionable, the name *lituratus* is technically valid.

Maximilian of Wied's *Phyllostoma superciliatum*, 1826.—Based on a single specimen found dead and much decomposed "bei der Fazenda von Tapebucú . . . nördlich von Cabo Frio zwischen den Flüssen S. João und Macahé," i. e. in the province of Rio de Janeiro. The author placed this bat ("Der Vampyr mit weissem Augengstreif") in a section of "*Phyllostoma*" headed "Unbestimmte Arten, deren Gebiss nicht untersucht werden konnte, welches aber wahrscheinlich mit dem der vorhergehenden Abtheilung übereinstimmt"; the preceding section has  $\frac{5}{5}$  "Backenzähne" (i. e.  $\frac{3}{3}$  molars). The statement is, of course, without any value, as the author admits it to be mere conjecture. In the rest of the extremely vague description there is nothing which prevents the identification of *Ph. superciliatum* with *A. j. lituratus*.

Rengger's "*Ph. superciliatum* Wied," from "Jhu," Paraguay, is no doubt *A. j. lituratus*. His specimen had no "weisse Spitzen der Flügelhaut"; but the amount of white at the tip of the wing (region of third, or second and third, phalanx of third digit) is individually very variable; examples occur in which it is but slightly indicated (very restricted, and clouded with dark colour).

Dobson's (Gray's) *A. grandis*, 1878.—The name "*Artibeus grandis*," quoted in Dobson's Catalogue from a manuscript label by Gray, but apparently never published by this latter author, refers to an unregistered spirit-specimen in the British Museum, an adult male without history; maxillary tooth-row 12 mm., forearm 70.8 mm. The specimen is indistinguishable from an ordinary *A. j. lituratus*.

J. A. Allen's *A. rusbyi*, 1904.—Based on the skin and skull of an individual from Yungas, Bolivia\*, 6000 feet. *A. rusbyi* is stated, by Allen, to be "nearly related to *A. palmarum* of Trinidad and adjoining parts of north-eastern South America, but differs in the

\* Allen writes, "Yungas, Peru" [i. e. the coast region round Trujillo, N.W. Peru]; but the specimen made by Allen, in 1904, the type of *A. rusbyi* had been mentioned, by the same author, on two previous occasions (Bull. Am. Mus. N. H. iii. (1890) pp. 170 & 172, and ix. (1897) p. 16) as being from "Yungas, Bolivia" [i. e. the eastern slopes of the Bolivian Cordilleras to the Amazonian plains]. I take the latter to be correct, but whether my conjecture is right or wrong is, for the identification of *A. rusbyi*, of no consequence.



lower, less convex, and more spreading brain-case, broader palate and heavier dentition, the upper tooth-row (canine and molar-premolar series) having a length of 11.5 mm. against 10.2 in *A. palmarum*; also in more prominent face stripes and darker coloration." Forearm 71 mm.; third metacarpal 69 mm.

I have had no adult specimen of the *Artibeus jamaicensis* section from Bolivia\*, but nine from Ecuador, S. and Central Colombia; they accord in every respect with Allen's description of *A. rusbyi*, being at the same time perfectly indistinguishable from *A. j. lituratus*. Allen gives as length of the maxillary tooth-row in his single specimen of *A. rusbyi* 11.5 mm., as against 10.2 in "*A. palmarum*"; in so far he had good reason to separate the former. But in 6 skulls of adult individuals of *A. j. lituratus* from the type locality, viz. Paraguay, the average length of the maxillary tooth-row is 11.6 mm.; in 19 adult skulls of the same race from various localities in Brazil 11.7 mm.; thus precisely as in the type of *A. rusbyi*.—The explanation, why Allen regarded *A. rusbyi* as an undescribed species, is evidently this: Allen compared *A. rusbyi* not with a series of *A. j. lituratus* from Paraguay or Brazil, but with an *unusually small-toothed A. j. palmarum*. I have examined 28 skulls of *A. j. palmarum*, and 10.2 mm., given by Allen as the length of the upper tooth-row in this form, is precisely the actual minimum in the whole series. Allen found the skull of *A. rusbyi* "lower" (less convex, &c.) than in *palmarum*; it only means that the skull of the type of *A. rusbyi* is in the adolescent stage, whereas the skull (or skulls) of *palmarum* with which he compared it must have been in the stage characteristic of adult and aged individuals; that these differences in the shape of the skull are dependent on age has been pointed out elsewhere in this paper (p. 248, text-figs. 50, 51). The colour characters mentioned by Allen are of no taxonomic value; individuals of *lituratus* and *palmarum* may be dark or light, their facial stripes strong or obsolete; these variations are partly dependent on age, partly purely individual.

In the table of measurements below, p. 277, I have arranged the adult specimens of *A. j. lituratus* in three sections according to their geographical habitat, viz. Paraguay, Brazil, and Ecuador—Central Colombia. In each of these sections are given the absolute minimum and maximum and the average, chiefly in order to show that individuals from these three regions are in every respect identical in size, *i. e.* vary within the same limits. It will be noticed that the average measurements of skulls (including teeth) from the three regions are perfectly alike; that averages of external measurements of individuals from Paraguay and Brazil are alike; and that the actual measurements of skulls, teeth, and external dimensions, within all these categories are

\* Specimen "1" in Dobson's Catalogue (p. 520), stated to be from Bolivia and "adult," is quite young; the correctness of the locality is questionable.

practically alike, when due consideration is taken of the fact that the number of individuals examined from each region is not the same. The external average measurements of the nine individuals from Ecuador, S. and Central Colombia, are somewhat larger than in the two other sections, but there is no reasonable doubt that this is quite accidental; in Paraguay individuals the difference between the absolute maximum and minimum of the length of the forearm is 9.5 mm., in the still larger Brazilian series 11 mm.; so that it is not very likely that in individuals from Ecuador and Colombia the amount of variation in this respect should be 4.5 mm. only; all of these latter individuals evidently happen to be rather large, none of them representing the minimum size, and consequently the average, as calculated from this series, is also above the true normal.

*Measurements of Artibeus jamaicensis lituratus.*

	Paraguay.			Brazil (detailed localities see p. 274).			Ecuador, S. & C. Colombia.		
	12 adults, 6 skulls.			20 adults, 19 skulls.			9 adults, 8 skulls.		
	MIN.	MAX.	MED.	MIN.	MAX.	MED.	MIN.	MAX.	MED.
Skull, total length, to front of e...	mm. 31.5	mm. 33	mm. 32.1	mm. 30.5	mm. 34	mm. 32.1	mm. 31.2	mm. 33	mm. 32
„ mastoid width .....	16.3	17.2	16.9	16.8	18	17.3	16.8	17.5	17.3
„ width of brain-case .....	13.8	14.2	14.1	13.8	15	14.1	13.8	14.8	14
„ zygomatic width .....	18.8	20	19.2	18.8	20.2	19.4	19.5	19.6	19.4
„ maxillary width across m <sup>1</sup>	13.2	14.7	14.1	13.6	15.2	14.5	13.3	14.2	13.9
„ across cingula of canines...	8.6	9.2	9	8.8	10	9.3	8.7	9.7	9
Mandible, to front of inc. ....	21.2	23.7	22.3	21.7	23.5	22.7	22	22.3	22.2
Upper teeth, c-m <sup>2</sup> .....	10.7	12	11.6	10.8	12.2	11.7	11.2	12	11.5
Lower teeth, c-m <sub>3</sub> .....	11.8	13.3	12.6	12.2	13.7	12.9	12	13	12.5
Ear-conch, length, inner margin	16.7	18	17.3	16.5	17.8				
„ length, outer margin .....	23	26	24	22.5	24				
„ width .....	15	17	16.1	15	17				
Tragus, length .....	7	8.8	7.8	7.2	7.8				
Lancet, length .....	11	12	11.3	10.8	11.5				
„ width .....	7	9	8.1	7	8.5				
Horseshoe, width .....	8.2	9	8.8	8	9.5				
Forearm .....	64	73.5	70.4	65	76	70.1	70.5	75	73.3
Pollex .....	16.5	17.8	17.1	15.5	18	16.6	14.2	17	16.4
3rd metacarpal .....	55.5	67.5	63.9	58.2	69	63.7	65.5	68.2	66.5
III <sup>1</sup> .....	18.2	24.8	21.9	19.2	25	21.8	22	24.5	23.2
III <sup>2</sup> .....	30.8	40	36.1	32.5	41	35.5	36.5	41	38.5
III <sup>3</sup> .....	18	21.7	19	16.8	21.2	18.6	18	21	19.3
4th metacarpal .....	55	66.7	62.5	56.8	67	62.5	63	67	65.2
IV <sup>1</sup> .....	17	21	18.6	17	20.8	19	18.5	21	19.7
IV <sup>2</sup> .....	19	24	22.5	19.8	25.2	22.3	22.2	25	23.9
5th metacarpal .....	57	70	65.1	58	70	64.4	65	70	67.9
V <sup>1</sup> .....	12.7	15.8	14.4	13	16	14.4	14.2	16	16.6
V <sup>2</sup> .....	15	19.5	17.6	15	19.7	17.4	17.2	20	18.8
Interfemoral .....	18.5	21.5	20	15	20				
Lower leg .....	25	27.8	26.2	24.3	28	26.9	26	27	26.7
Foot, with claws .....	17.8	20.5	18.7	17	20	18.5	17.2	20	18.3
Calcar .....	7	10	8.8	7.8	10	8.5	8	10	8.9

## ARTIBEUS JAMAICENSIS PALMARUM All. &amp; Chapm.

1878. *Artibeus perspicillatus* (partim, not L.) Dobson, Cat. Chir. Brit. Mus. pp. 519-20, specimens *u*, *p*, *r*, *s*, *t*, *v*, *y*, *z*.—Venezuela, Costa Rica, Guatemala.
1893. *Artibeus perspicillatus* (not L.) Thomas, Journ. Trinidad Field Nat. Club, i. no. 7, p. 6 (April 1893).—Trinidad.
1893. *Artibeus* sp. n., J. A. Allen & Chapman, Bull. Am. Mus. N. H. v. Art. 13, p. 208 (21 Sept. 1893).—Trinidad.
1897. *Artibeus palmarum* J. A. Allen & Chapman, Bull. Am. Mus. N. H. ix. Art. 2, p. 16 (26 Feb. 1897).—Type locality: Trinidad.
1897. *Artibeus intermedius* J. A. Allen, Bull. Am. Mus. N. H. ix. Art. 3, pp. 33-34 (11 March, 1897).—Type locality: San José, Costa Rica.
1899. *Artibeus femurrillosus* Outram Bangs, Proc. New Engl. Zool. Club, i. pp. 73-74 (24 Nov. 1899).—Type locality: Santa Marta, Colombia.
1900. *Artibeus palmarum* All. & Chapm., J. A. Allen, Bull. Am. Mus. N. H. xiii. Art. 8, p. 89 (12 May, 1900).—Santa Marta, Colombia.
1901. *Artibeus palmarum* All. & Chapm., Robinson & Lyon, Proc. U.S. Nat. Mus. xxiv. pp. 148-49.—La Guaira, Venezuela (specimens examined).
1902. *Artibeus intermedius* All. (partim), Outram Bangs, Bull. Mus. Comp. Zool. xxxix. no. 2, p. 50 (April 1902).—Bogava, Chiriqui (the larger specimen recorded by the author).

*Diagnosis*.—Precisely similar to *A. j. lituratus*, but skull and teeth averaging slightly smaller.

*General characters*.—As in *A. j. lituratus* the notch in the hinder margin of  $m^2$  is comparatively rarely (in 10 p. ct. of the skulls examined) as distinct as in *A. planirostris*, in the large majority either noticeably reduced in size or quite filled up. The skull is subject to the same modifications depending on age (text-figs. 50, 51, on p. 248). The light colour type is predominant, especially in aged individuals, but common also in adults with unworn teeth. The supraorbital stripes are as a rule, the infra-orbital stripes often, well developed.

*A. j. palmarum* and *lituratus*.—Externally *A. j. palmarum* is indistinguishable from *A. j. lituratus*; there is no structural difference in any respect; the dimensions vary within the same limits, and even the average dimensions are practically quite the same. But there is a small average difference in the size of the skull and teeth:—the length of the skull averages 1.3 mm. (only about 4 p. ct.!) shorter, the width of the skull from 0.4 to 0.9 mm. narrower, the maxillary tooth-row 0.7 mm. shorter.

I should not have tried to keep this form separate from *A. j. lituratus*, if the name *palmarum* had not been available. The separation is artificial rather than natural; the trifling average difference pointed out above will, I believe, hold good also for much more extensive series of both forms; but it is a matter of fact that in the large majority of cases *A. j. palmarum* cannot practically be discriminated from *lituratus*.

*A. j. lituratus* and *palmarum* taken together (and as mentioned above it would be both more natural and more convenient to unite the two "forms") are distributed from S. Brazil to S. Mexico, including the coast islands of Trinidad and St. Vincent, but excluding the whole of the West Indies proper.

In Central America and S. Mexico *A. j. palmarum* meets the considerably smaller *A. j. jamaicensis*. There is no doubt what-

ever that the latter race is the truly indigenous form in the region north of Panama, and that *A. j. palmarum* is a late intruder from south into the same region. This point will be further discussed in the "General Remarks," below p. 317.

*Size*.—In the table of measurements p. 282, the specimens examined have been arranged in four sections, viz. individuals from (1) Venezuela, (2) Trinidad and St. Vincent Islands, (3) Central America, and (4) S. Mexico. The table shows that measurements of individuals from these four areas are identical. The four specimens from S. Mexico (Oaxaca, Vera Cruz, Jalisco) do not show the extremes of individual variation in size; hence the average measurements are not given.

*Specimens examined*.—47 specimens (26 skins) and 32 skulls, from the following localities:—

British Museum:—Trinidad (4).—St. Vincent Island (1).—Venezuela: Caripé (1); Tachira (1); "Venezuela" (1).—Panama: Bogava, Chiriqui, 250 m. (4).—Costa Rica: San José (3); Los Cuadros, S. Pedro (1); Costa Rica (2).—Nicaragua: Matagalpa (1).—Guatemala: Dueñas (4); Cahaban (1).—"Central America" (1).—Jalisco: Huajimic, Tepic (1).—18 skulls, from all the localities enumerated.

U.S. National Museum\*:—Trinidad (1).—Venezuela: Macuto, La Guaira (12).—Costa Rica: San José (3).—Nicaragua: Escondido River, 50 miles from Bluefields (1).—Guatemala: Peten (1).—Oaxaca: Santo Domingo (2).—Vera Cruz: Mirador (1).—14 skulls, representing all these localities.

*Range*.—Venezuela, including Trinidad and St. Vincent Islands, through Central America, to Vera Cruz and Jalisco, Mexico.

Allen and Chapman's *A. palmarum*, 1897.—In 1893 (*l. s. c.*), Allen and Chapman recorded an "*Artibeus sp. nov.*?" (skin without skull) from Trinidad; it differed "in coloration and in the distribution of the fur on the wing-membranes from any of the currently recognised species of *Artibeus*;" forearm 63, third metacarpal 61, tibia 25.4 mm.; "color above and below light brown, much lighter on the head and anterior half of the body, the hairs nowhere tipped with gray; a broad white stripe above and a faint whitish line below each eye."

The same specimen, together with six others, also from Trinidad, formed, in 1897 (*l. s. c.*), the basis for Allen and Chapman's *A. palmarum*:—"From true *Artibeus perspicillatus*," the authors write, "the present species differs notably in colour, particularly in the presence of two prominent broad white head stripes, and two narrower and shorter whitish cheek stripes. It is also very much larger, the forearm measuring 68 mm. against 56 in true *perspicillatus*, with all the other dimensions proportionately larger. The skull is much more massive, at least one-third

\* U.S. N. M. nos.:—6973 (37809), 7222, 13778, 13809 (37551), 51571, 73257-58, 101331, 102843, 102845-46, 102855-56, 102860-62, 102873-74, 102877, 102879, 103964.

larger in general bulk, and about one-sixth larger in linear measurements." Forearm of type 68, third metacarpal 64; length of skull 31, zygomatic width 19 mm.

Later on, in 1900 (*l. s. c.*), *A. palmarum* was recorded by Allen from Bonda, Santa Marta region, Colombia, and Cali, S. Colombia; in 1901 (*l. s. c.*), by Robinson and Lyon from La Guaira, Venezuela.

To understand what led Allen and Chapman to separate *A. palmarum* as a distinct species the following must be borne in mind:—Allen and Chapman identified Linné's *Vespertilio perspicillatus* (1758) with the bat later on (1822) described by Leach, on the basis of a Jamaica specimen, as *Artibeus jamaicensis* (*A. j. jamaicensis* of the present paper)\*; having found that the Trinidad representative of this type of bat differed [to a certain degree] in size and colour from the Jamaica bat and, consequently, required a name of its own, they called the Trinidad form *A. palmarum*. In so far all is clear: the Trinidad bat is, in fact, as a rule distinguishable from the West Indian form. But Allen and Chapman were mistaken in their identification of Linne's *V. perspicillatus* (Seba's *V. Americanus vulgaris*), which, as pointed out by Oldfield Thomas, is not Leach's *A. jamaicensis*, but the bat commonly called *Carollia brevicauda*; further, although there is a very well-marked average difference in size and colour between Trinidad and Jamaica individuals of *A. jamaicensis*, there is absolutely no "hard-and-fast" line between them, so that they cannot be separated *specifically*; again, the Trinidad (Venezuelan, Colombian) bat comes so exceedingly near to the common Brazilian form of the species that it, for all practical purposes, is completely indistinguishable from this latter; and, last, this Brazilian form had already a name, viz. *A. j. lituratus* Licht.—The infinitesimal average difference in the size of the skull between *A. j. lituratus* and *A. j. palmarum* is the only reason (if reason it can be properly called) on the strength of which the latter can be kept separate as a "race."

J. A. Allen's *A. intermedius*, 1897.—Type locality: San José, Costa Rica. According to Allen, *A. intermedius* is "rather smaller than *A. palmarum*," "apparently intermediate between *A. palmarum* and *A. perspicillatus* [i. e. *A. j. jamaicensis*]," but "much darker, with the head stripes narrower and much less distinct, and the cheek stripes obsolete"; "brain-case narrow and high, the dorsal outline remarkably convex;" forearm 65, third metacarpal 57; length of skull 29, zygomatic width 19 mm.

*A. intermedius* was based on two adult and five "nearly full-grown" young individuals. If Allen had had a larger series of adults he would have found that the colour characters on which he laid stress are of no diagnostic importance; in Costa Rica, as elsewhere throughout the whole area occupied by *A. j. lituratus*

\* Allen & Chapman, Bull. Am. Mus. N. H. ix. Art. i. pp. 3-5 (23 Feb. 1897).

and *palmarum*, some individuals are of the dark, others of the light colour type, some have the superciliary stripes less distinct or even obsolete, while others (and these the majority, in Costa Rica and elsewhere) have them well marked or even very strong; the infraorbital are always less pronounced than the supraorbital stripes; the colour characters given by Allen must therefore be left out of consideration when judging the validity of "*A. intermedius*."—When Allen found the type of *A. intermedius* "apparently intermediate [in size] between *A. palmarum* and *A. perspicillatus*," it is only because the specimen happens to be a small-sized individual; in the series from the type locality and adjoining regions of Central America examined by myself, there are several examples as small as (and slightly smaller than) Allen's specimen, but these represent unquestionably the *minima* of size; the other extreme is shown by the following measurements of the forearm: in two specimens from Chiriqui 70.5 and 72 mm., two from Costa Rica 71 and 73 mm., two from Nicaragua 71 and 73 mm., three from Guatemala 70, 72, and 72.5 mm.; the rest of the individuals are, of course, intermediate in size between these two extremes. Thus, also the size-character given by Allen must be dropped.—There remains the shape of the skull; but as pointed out above (p. 248, text-figs. 50, 51), this "remarkably convex" brain-case (sagittal crest produced forward, supraorbital ridges directed almost straightly outward, well developed post- and anteorbital processes) is an age character in *A. j. lituratus* and *palmarum*, not a specific character; it is by no means peculiar to Central American individuals, but occurs, to the same degree, in individuals from Paraguay, Brazil, Colombia, Venezuela, Trinidad, &c. I have carefully compared Central American (and Mexican) specimens with Trinidad and Venezuelan specimens of *A. j. palmarum*, and am unable to find any difference whatever.

In 1902 (*L. s. c.*), Outram Bangs recorded three "*A. intermedius*" from Bogava, Chiriqui, one old ♀, one youngish ♂, and one youngish ♀, and wrote:—"The younger specimens are more sooty, with the facial stripes less well indicated, and have smaller skulls . . . The difference in size is great, and the skulls do not show the degree of immaturity that one would expect with the difference in size." The explanation is this: the two youngish specimens (provided they are really full-grown) were, no doubt, *A. j. jamaicensis*, the old female an *A. j. palmarum*. It cannot be too strongly emphasised that Central America and S. Mexico are inhabited by two forms of *A. jamaicensis*—the one, and small, is the truly indigenous race, *A. j. jamaicensis*, occurring also in Jamaica, San Domingo, Porto Rico, eastwards at least to St. Kitts; the other, and larger, is *A. j. palmarum* (or, if preferred, *A. j. lituratus*), which has come from south,—two forms which till now have been mixed together. As the two races are not perfectly differentiated "species," one cannot expect them to be separable in all particular instances; but many individuals can be identified at a glance, and whenever the external characters

leave the identification unsettled, a careful examination of the skull and teeth will, with rare exceptions, decide the matter. It is a case parallel to that of *Hipposiderus caffer caffer* and *H. c. centralis* in British and German East Africa\*; two very well marked modifications of one common type, differing in size only, and originally, no doubt, occupying quite separate areas, but the latter has in the course of time spread over a part of the region of the former, as has *A. j. palmarum* over that of *A. j. jamaicensis*; in the one instance as in the other the races are, however, on careful examination almost always separable, even when found together on the same spot.

Outram Bangs's *A. femurvillosus*, 1899.—Type locality: La

*Measurements of Artibeus jamaicensis palmarum.*

	Venezuela (Macuto, Caripé, Tachira).			Trinidad, St. Vincent Island.		Central America (Panama, Costa Rica, Nicaragua, Guatemala).			Mexico (Vera Cruz, Jalisco, Oaxaca).	
	15 adults, 10 skulls.			4 adults, 3 skulls.		20 adults, 15 skulls.			4 adults, 3 skulls.	
	Min.	Max.	Med.	Min.	Max.	Min.	Max.	Med.	Min.	Max.
Skull, total length, to front of c	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
" mastoid width	30	32	31	...	31	29.7	31.8	30.6	30	30.7
" width of brain-case	16.2	17.5	17	...	16.2	15.8	17.6	16.8	16.2	17
" zygomatic width	13	14	14	...	13.8	13.6	14.5	14	13.8	14
" maxillary width across m <sup>1</sup>	17.1	20.3	18.9	...	20	18	20	18.9	18.8	19.2
" across cingula of canines	13	14	13.4	14	14.6	13	14	13.5	13.2	13.8
Mandible, to front of inc.	8.5	9	8.9	8.1	9	8.2	9.1	8.7	8.2	9
Upper teeth, c-m <sup>2</sup>	20.8	22.5	21.5	...	22.2	20	22.6	21.4	20.7	21.2
Lower teeth, c-m <sup>3</sup>	10.5	11.8	11.2	11	11.8	10.2	11.2	10.9	10.3	11.7
Ear-couch, length, inner margin	11.6	12.7	12.2	12	12.8	11.7	12.7	12.2	11.2	11.5
" length, outer margin	16	17.7	16.6	16	18	15.5	17.3	16.7	...	16.5
" width	21	24.5	23.2	23	25	21	26	23.6	...	24.5
Tragus, length	15	16.3	15.5	16	16.5	15.2	17.7	16	...	17
Lancet, length	7.8	8.5	8	7	8.5	7.7	8	7.9	...	7
" width	9.8	12	11	10	11.7	10	11.5	10.7	...	11.2
Horseshoe, width	7	8.8	7.9	7.5	8.5	7	8.8	7.9	...	8.2
Forearm	8.2	9.8	8.9	8.8	9.2	8.3	9.8	8.9	...	...
Pollex	68.2	75.8	71	67.5	72.5	64	75	70.6	68	71
3rd metacarpal	15	17.7	17.1	15.2	17.5	15	16.8	16.1	15.7	15.7
III <sup>1</sup>	61.7	68.5	64.6	60	68	58.8	66.5	63.8	58.5	63
III <sup>2</sup>	21	24.8	22.8	19.2	23.2	20	24	22.4	20	22.2
III <sup>3</sup>	31	39.8	36.4	33	38.2	33	39	36.7	33.7	35.8
4th metacarpal	16.8	20.2	18.2	17.7	21	17.2	20.8	18.7	17	18.7
IV <sup>1</sup>	59.7	66.5	63.3	58.5	66	58	66.2	62.6	58	61.5
IV <sup>2</sup>	17.8	21	19.1	17.5	19.2	17.2	21.5	19	17.5	18.8
5th metacarpal	20	24.2	22.5	20.8	24	21	25.8	23.3	20.8	23
V <sup>1</sup>	61.7	69	65.8	61.8	68.5	59.5	67.3	64.5	59.2	65
V <sup>2</sup>	12.8	16	14.8	12.8	16	14.2	17	14.7	14	14.8
Interfemoral	15.2	19.8	17.8	14.7	19.2	16.8	20	18.3	16	18
Lower leg	17.5	21	19.2	17	18	17	22	19.6	15	...
Foot, with claws	24	27	25.5	25	27.5	24	26.8	25.6	22.8	24.5
Calcar	17	19.8	18.4	17.8	19	16.5	20	18	16.2	17.8
	7.7	10.2	9.1	7.5	9.7	7.2	9	8.6	7.2	...

\* Knud Andersen, Ann. & Mag. N. H. (7) xvii. p. 281; March 1906.

Concepcion, Sierra Nevada de Santa Marta, Colombia, 3000 feet.—The essential points in the original description are these:—“About the size of *A. palmarum*, differing from that species in having but one pair of face stripes (no cheek stripes) . . . these stripes narrow and not very conspicuous. The new species differs from all others of the genus I have seen in having the upper surfaces of legs, feet, and interfemoral membrane clothed with short fur. In the allied species these parts are naked.” Length of forearm, metacarpals and phalanges not given by the author; it is unnecessary to quote the measurements of the skulls, as they are precisely as in many *A. j. palmarum*.—*A. femurvillosum* was half a year later (1900, *l. s. c.*) put down by Allen as a synonym of “*A. palmarum*.”

The colour characters given by Bangs need no comment; they are valueless for diagnostic purposes. The statement that the upper surfaces of the legs, feet, and interfemoral are naked in “the allied species,” is a mistake; in all the specimens I have seen of *A. jamaicensis*, of any race, they are hairy. Thus nothing is left by which *A. femurvillosum* can be discriminated from *A. j. palmarum*.

#### ARTIBEUS JAMAICENSIS PRÆCEPS K. And.

1906. *Artibeus jamaicensis præceps* Knud Andersen, Ann. & Mag. N. H. (7) xviii. p. 421 (1 Dec. 1906).—Type locality: Guadeloupe, W. I.

*Diagnosis*.—Similar to *A. j. palmarum*, but forearm and hand averaging shorter.

*A. j. præceps* and *palmarum*.—Individuals of *A. jamaicensis* from Trinidad and St. Vincent Island are indistinguishable from the continental *A. j. palmarum* (or, if this form is not recognised, from *A. j. lituratus*). From the Windward Islands between St. Vincent and Dominica I have had no specimens.—In Dominica and Guadeloupe *A. j. palmarum* is replaced by the slightly differing *A. j. præceps*. Three skulls of this race are practically almost indistinguishable from the ordinary *palmarum* skull; they show a tendency to go slightly below the minimum size in the large number of *palmarum* skulls examined, so that there can scarcely be any doubt that, in a more extensive series, skulls of *præceps* will prove to average a little more slenderly built. The teeth will probably also average slightly smaller. There is a similar indication of a decrease in the external dimensions, especially noticeable in the length of the forearm and hand: in the three adult examples of *A. j. præceps* the forearm measures 60, 65.5, and 66.2 mm., in 43 adult examples of *A. j. palmarum* the average length of the forearm is 70.9 mm., and none has the forearm less than 64 mm.; of the whole series of *palmarum* two only (5 p. ct.) have the forearm less than 66.5 mm., whereas in all examples of *præceps* available the forearm falls short of that length; for further details (metacarpals, proximal phalanges, tibiae) see table of measurements below, p. 284.—From the



Summary of measurements of the Geographical Races of *Artibeus jamaicensis*.

	<i>parvipes</i> .	<i>guatemalensis</i> .	<i>jamaicensis</i> .	<i>aequatorialis</i> .	<i>lituratus</i> .	<i>palmarium</i> .	<i>proceps</i> .
	25 adults, 12 skulls.	14 adults, 12 skulls.	95 adults, 65 skulls.	7 adults, 6 skulls.	41 adults, 33 skulls.	43 adults, 31 skulls.	3 adults, 3 skulls.
	AVERAGE. mm.	AVERAGE. mm.	AVERAGE. mm.	AVERAGE. mm.	AVERAGE. mm.	AVERAGE. mm.	MIN. MAX. mm. mm.
Skull, total length to front of c	26.9	27.4	28.3	29.7	32.1	30.8	14.5 16.2
" mastoid width	14.4	14.6	15.1	15.8	17.2	16.8	15 16
" width of brain-case	12.1	12.3	12.7	13.1	14.1	14	12.7 13.2
" zygomatic width	16.1	16.8	17.4	18.3	19.4	18.9	17.8 18.2
" maxillary width across m <sup>1</sup>	11.8	12.1	12.6	13.6	14.4	13.5	13.2 13.6
" across cingula of canines	7.5	7.7	8.1	8.9	9.2	8.8	8.6 8.7
Mandible, to front of inc.	18.4	18.9	19.5	21.1	22.6	21.5	20.4 20.8
Upper teeth, c-m <sup>2</sup>	9.7	9.9	10.3	11	11.7	11	10.8 10.8
Lower teeth, c-m <sup>3</sup>	10.4	10.7	11.1	12.1	12.8	12.2	11.6 11.7
Ear-conch, length, inner margin	14.4	.....	14.8	.....	17.2	16.7	14.5 16.2
" length, outer margin	20.3	.....	21.4	.....	24	23.4	20 22
" width	14.2	.....	21.3	.....	16	15.8	15 16
Tragus, length	6.8	.....	7	.....	7.8	7.9	7.5
Lancet, length	9.3	.....	9.6	.....	11.3	10.8	10
" width	6.4	.....	6.8	.....	8	7.9	7 7.2
Horseshoe, width	7.3	.....	7.6	.....	8.8	8.9	8.2
Forearm	56.8	59.6	60.1	62.9	70.2	70.9	60 66.2
Polex	13.9	13.7	14.2	14.4	16.8	16.5	15.5 16.5
3rd metacarpal	51.3	53.8	53.7	56.9	63.8	64.2	54.8 61
III <sup>1</sup>	16.3	17.2	17.3	18.4	21.8	22.5	18 19
III <sup>2</sup>	27.3	28.8	28.8	30.9	35.7	36.5	30.2 34
III <sup>3</sup>	14.5	14.6	15.5	16.9	18.8	18.5	16.2 17.8
4th metacarpal	50.2	53	52.9	55.4	62.5	62.9	54 60
IV <sup>1</sup>	14.5	15.3	15.2	16.6	18.9	19	16.2 16.8
IV <sup>2</sup>	17.9	19	19.9	22.4	25.4	22.9	19.7 22
5th metacarpal	51.9	54.5	54.7	57.2	64.7	65.1	55.5 61.5
V <sup>1</sup>	11.3	11.7	11.9	12.8	14.4	14.8	11.8 12.8
V <sup>2</sup>	13.0	14.6	14.5	15.4	17.5	18	14.8 16.8
Interfemoral	14.1	.....	15.5	.....	19.3	19.3	14.5 20.5
Lower leg	21.6	22.2	22.8	24.1	26.6	25.6	23 25
Foot, with claws	15.4	15.7	16.1	16.8	18.6	18.2	17 18.2
Calcus	6.4	.....	6.5	7.2	8.6	8.8	6 6.7

islands between Guadeloupe and St. Kitts no specimens have been available. St. Kitts is inhabited by *A. j. jamaicensis*, the range of which, so far as the West Indies are concerned, extends from here westwards over Porto Rico and San Domingo to Jamaica.

*A. j. præceps* comes in every respect considerably nearer to its southern neighbour, *A. j. palmarum*, than to its western neighbour, *A. j. jamaicensis*. From this it seems reasonable to conclude that it is a northern offshoot of *A. j. palmarum*, not an eastern offshoot of *A. j. jamaicensis*.

It would be practically impossible to discriminate *A. j. præceps* from *A. j. æquatorialis*; but the latter is a large southern representative of *A. j. jamaicensis* inhabiting Ecuador and S. Colombia, the former a slightly diminished insular representative of *A. j. palmarum*, inhabiting, as just pointed out, certain islands between St. Vincent and St. Kitts. Their extremely close resemblance is a coincidence; the descent of the two races is different, and they occupy widely separated areas; they have acquired similar features, but by different lines of development.

*Specimens examined*.—Dominica (1), Guadeloupe (2). With skulls. From the collection of the U.S. National Museum\*.

*Range*.—As yet known only from Dominica and Guadeloupe, W. I.

#### ARTIBEUS GLAUCUS THOS.

1844. ? *Phyllostoma pusillum* (not Natterer) Tschudi, Fauna Peruana, pp. 63-64.

1893. *Artibeus glaucus* Thomas, P. Z. S. 1893 (18 April) pp. 336-37, pl. xxix. figs. 7-9.—Type locality: Chanchamayo, Peru.

*Diagnosis*.—Molars  $\frac{3}{4}$ . Cusp 7 of  $m^1$  small. Forearm 43.8 mm.

*Skull*.—In shape the skull is almost precisely similar to that of *A. hirsutus*, *planirostris*, or *jamaicensis*, the only appreciable difference being the slightly lower brain-case; but it is much smaller: in linear dimensions  $\frac{3}{4}$ , in bulk less than  $\frac{1}{2}$ , the size of an *A. hirsutus* skull.

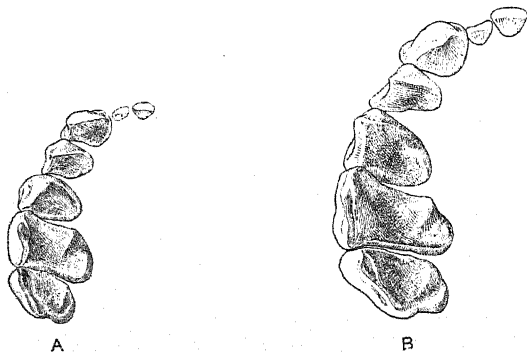
*Teeth*.—Differ from those of *A. concolor*, *planirostris*, and *hirsutus*, and accord with those of *A. jamaicensis*, in the complete disappearance of  $m^3$ ; differ from those of all the species mentioned chiefly in the less developed lingual parts of the premolars and molars (particularly of  $m^1$ ), and in the much smaller size of all the teeth.

The inner heels of  $p^3$  and  $p^4$  are proportionately slightly smaller than in the foregoing species. In all of these latter there is a small, but perfectly distinct, cusp rising from the antero-internal margin of the heel of  $p^1$ ; in *glaucus* this cusp is practically wanting (an exceedingly faint indication of the cusp is detectable by the aid of a strong lens). Cusp 7 of  $m^1$  (the postero-internally projecting portion of the tooth) is considerably less developed than in any of the foregoing species; in the single skull available it is not much more than a distinctly projecting

\* U.S. N. M. nos. 113503-4, 113628.

ledge, whereas in *jamaicensis* (and in *concolor*, *planirostris*, and *hirsutus*) it is equal to from one-third to one-fifth the area of the tooth. The angular emargination in the posterior border of  $m^2$  (into which  $m^3$  is pressed in those species which possess this rudimentary tooth, and which, as pointed out above, pp. 250-252, is very often preserved in *A. jamaicensis*, although this species has lost  $m^3$ ) is in *glaucus* but faintly indicated, the whole postero-internal portion of  $m^2$  being formed by the slightly projecting cusp 7.—The lower teeth do not differ in structure from those of the foregoing species; the small  $m_3$  is still more reduced in size.

Text-fig. 53.



A. *Artibeus glaucus*, ♀ ad. Chanchamayo, Peru. Type, B.M. 94.8.6.13.  
Right upper tooth-row.  $\times \frac{1}{4}$ .

B. *Artibeus jamaicensis jamaicensis*, ♂ yg. ad. Jamaica. B.M. 7.1.1.677.  
Right upper tooth-row.  $\times \frac{1}{4}$ .

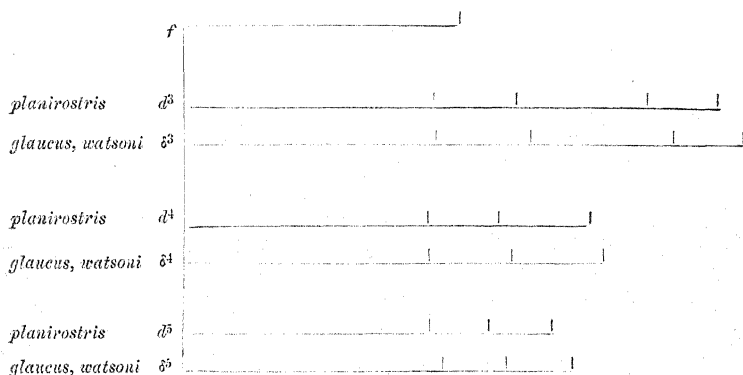
*Nose-leaves*.—Front margin of horseshoe free, simple.

*Tragus*.—Two indistinct serrations on the outer margin above the median projection; in a larger series some individual variation will be found in this respect.

*Wings*.—The third, fourth, and fifth digits are proportionately longer than in the *planirostris* and *jamaicensis* sections; in *planirostris* the indices of these digits (including the metacarpals, but excluding the terminal cartilaginous rods of the distal phalanges) are, respectively, 1945, 1477, and 1346; in *glaucus* and *watsoni* (which are similar in the wing-structure as in almost all other respects), 2025, 1497, and 1405; as proved by these figures, particularly the third and fifth digits are lengthened\*, to a less degree the fourth. A

\* "Lengthened" means here simply longer as compared with the digits of bats of the *planirostris* and *jamaicensis* type; it does not imply that the writer is of opinion that the wing-structure of *glaucus* and *watsoni* can, phylogenetically, be derived from that of the *planirostris-jamaicensis* type. We have no means to determine, with any degree of probability, which of these wing-structures is the more primitive, i. e. comes nearest to that of the prototype of the genus.

closer examination shows that not all parts of the digits have been lengthened in *glaucus* and *watsoni*; the metacarpals are practically quite as in *planirostris* and *jamaicensis* (the fifth metacarpal very slightly lengthened), but the first and second phalanx of the third digit, and the first phalanx of the fourth and fifth digits are noticeably longer. The wing-indices on p. 310, and the diagram below show the details. One fact resulting from this modification is worth noticing: both the first and the second phalanx of the third digit are lengthened, but the former considerably more than the latter (lengthening of first phalanx 57, of second only 27 mm., for an assumed length of forearm of 1000 mm.). The result is that, whereas in the *planirostris* and *jamaicensis* type the second phalanx of the third digit is very distinctly more than  $1\frac{1}{2}$  the length of the first, it is in *glaucus* and *watsoni* always less than  $1\frac{1}{2}$  of the first, a peculiarity easily ascertained on careful examination of the wings of these bats.



*f*, forearm. Given this length of the forearm, the third, fourth, and fifth digits have in *A. planirostris* the lengths indicated by the lines d<sup>3</sup>, d<sup>4</sup>, and d<sup>5</sup>, in *A. glaucus* and *watsoni* the lengths indicated by the lines d<sup>3</sup>, d<sup>4</sup>, and d<sup>5</sup>. The subdivisions of d<sup>3</sup> and d<sup>5</sup>, in direction from left to right, indicate the metacarpal, first, second, and third phalanx; those of d<sup>4</sup>, d<sup>4</sup>, and d<sup>5</sup>, the metacarpal, first and second phalanx.

*Hairing on limbs and membranes.*—Above, the proximal two thirds of the forearm densely haired; a tuft of hairs on the metacarpal of the pollex; the interfemoral, femur, tibia, and foot to the claws, covered with very short sparse hairs. Below, the interfemoral hairy along the middle, almost naked laterally.

*Colour.*—The fur of the only specimen on record, a young adult female (full-grown, but epiphyses of metacarpals separate) preserved in alcohol, has the following colour:—Upper side greyish drab with a slight tinge of fawn, base of hairs lighter, washed with ecru-drab. Under side light greyish drab. White supraorbital and infraorbital stripes distinct. Apparently no white margins to the ears.

*Measurements*.—On p. 289.

*Specimens examined*.—One, the type, in the collection of the British Museum.

*Range*.—Chanchamayo, Junin, Central Peru.

Tschudi's *Phyllostoma pusillum*, 1844.—Indeterminable from the description; the author refers only to the colour, the nose-leaves, ears, membranes, and general size; neither to the skull nor to the teeth. The only measurement of any practical value is that of the forearm, "1" 5'" (*i. e.* 37 mm.); if this measurement was taken according to the same method as used in the present paper, and if the specimen measured was full-grown, then Tschudi's bat was not an *A. glaucus*; if an *Artibeus* (not a *Vampyrops*), it may have been *A. rosenbergi*.—Even if Tschudi's *Ph. pusillum* were proved to be *A. glaucus*, the latter name would have to stand, the former being preoccupied by Natterer's *Ph. pusillum*, which is *Vampyressa pusilla*\*.

#### ARTIBEUS WATSONI Thos.

1901. *Artibeus watsoni* Thomas, Ann. & Mag. N. H. (7) vii. pp. 542-43 (1 June, 1901).—Type locality; Bogava, Chiriqui.

1804. *Artibeus watsoni* Thos., J. A. Allen, Bull. Am. Mus. N. H. xx. Art. iv. p. 79 (29 Feb. 1904).—Boqueron, Chiriqui.

*Diagnosis*.—Similar to *A. glaucus*, but smaller. Forearm 37·2-40·5.

*A. watsoni* and *glaucus*.—*A. watsoni* is a Central American representative of the *A. glaucus* type, differing from the Peruvian species only in the rather smaller size, proportionately slightly longer ears, and longer interfemoral.

The skull is quite of the same shape as in *glaucus*, but a trifle smaller, especially narrower; of nine skulls of *watsoni* none reaches the single skull of *glaucus* in size.

The teeth are in every respect (including the size) as in *glaucus*. There is, as a rule, a faint remnant of the notch in the hinder margin of  $m^2$ , between its cusps 5 and 7, but in some individuals also this trace has disappeared, the margin being perfectly simple.

The horseshoe is free all round, the margin sometimes simple, sometimes finely crenulate.

The ears are, apparently, proportionately a little longer, and rather narrower in their upper half (less broadly rounded off) than in *glaucus*; but of nine specimens examined of *watsoni* two only are preserved in alcohol, and only one specimen of *glaucus* is available for comparison. Three small serrations on the outer margin of the tragus above the median projection.

Both the alcoholic specimens have the interfemoral markedly longer than in *A. glaucus*: 11·8 and 13·5 mm., as against 8 mm.

On the wing-structure, see *A. glaucus* (above, p. 287). Hairing on limbs and membranes as in *A. glaucus*.

\* Thomas, Ann. & Mag. N. H. (6) iv. pp. 169-70 (Aug. 1889); and (7) v. p. 270 (March 1900).

*Measurements of Artibeus glaucus and watsoni.*

	<i>A. glaucus.</i>	<i>A. watsoni.</i>		
	♀ yg. ad. Type.	9 adults, 9 skulls.		
	mm.	Min.	Max.	Med.
Skull, total length to front of c	21.2	mm. 18.7	mm. 20.8	mm. 19.7
" mastoid width	11	9.8	10.8	10.1
" width of brain-case	9.5	8.7	8.8	8.7
" zygomatic width	12	11.2	11.8	11.6
" maxillary width across m <sup>1</sup>	8.8	8.2	8.6	8.4
" across cingula of canines	5.8	5.5	6	5.7
Mandible, to front of inc.	14	12.5	13.9	13.1
Upper teeth, c-m <sup>2</sup>	6.8	6.5	7	6.7
Lower teeth, c-m <sub>3</sub>	7.2	6.8	7.5	7.1
Ear-conch, length, inner margin	10.5	11	12	
" length, outer margin	14	15	16.2	
" width	12	12	12.2	
Tragus, length	4.8	5.5	6.2	
Lancet, length	9.2	8.5	9	
" width	5	5.2	6.2	
Horseshoe, width	6.5	6.3	7	
Forearm	43.8	37.2	40.5	39
Pollex	11	9.5	11	10.2
3rd metacarpal	39.4	33.7	36.2	35.3
III <sup>1</sup>	15.8	13	15	13.9
III <sup>2</sup>	23	18.7	21	20
III <sup>3</sup>	12.8	8.8	11.2	10.2
4th metacarpal	39	33.2	36.2	34.7
IV <sup>1</sup>	13	11	12.2	11.6
IV <sup>2</sup>	15	11	13.5	12.3
5th metacarpal	41	33.8	37.5	36.1
V <sup>1</sup>	11	8	9.5	8.7
V <sup>2</sup>	12	9	11.2	10.2
Interfemoral	8	11.8	13.5	
Lower leg	14.5	12.8	14.7	13.7
Foot, with claws	10.3	9.2	10	9.7
Calcar	4.5	4.2	5.2	4.7

*Colour.*—Of six skins, four are dark, two lighter coloured.

Darker stage; 4 skins, Bogava (Chiriqui) and Cebaco I.; full-grown, teeth unworn or slightly worn, epiphyses of metacarpals separate in one, ossified in the others:—Upper side from the shoulders backward sepia-brown (browner than Ridgway's "sepia"), this colour confined to the narrow tips of the hairs; base of hairs drab. Front part of upper side, from the shoulders forward, of a rather lighter shade, more drabbish brown, owing to the darker hair-tips being extremely short or wanting; base of hairs approaching ecru-drab; there is no contrast between the hinder and anterior part of the back, the colour of the former shading gradually into that of the latter. Under side dark grey. White supra- and infraorbital stripes strongly pronounced. Ear-conch very narrowly margined with white. Tip of the third digit and adjoining membrane not lighter-coloured.—The four specimens are almost alike in the shade of the colour.

Lighter stage; 2 skins, Bogava (Chiriqui) and Sevilla I.; full-grown, teeth unworn, epiphyses of metacarpals ossified.—Upper side wood-brown, washed with a slightly darker shade on the hinder back; base of hairs ecru-drab on the hinder back, whitish washed with ecru-drab in front of the shoulders. Under side lighter wood-brown. Facial stripes strong. Narrow white edgings to the ears. No light-coloured tips to the wings.—The two specimens are almost alike in colour, rather strongly contrasting with the four described above.

*Measurements*.—On p. 289.

*Specimens examined*.—9 specimens (two in alcohol, one skin in alcohol, six dried skins) with skulls, from the following localities:—

British Museum :—Bogava, Chiriqui, Panama (5); Cebaco I., Panama (2); Sevilla I., Panama (1).

U.S. National Museum\* :—Escondido River, Nicaragua (1).

*Range*.—Central America (Panama, Nicaragua).

#### ARTIBEUS CINEREUS Gervais.

*Diagnosis*.—Molars  $\frac{2}{3}$ . Cusp 7 of  $m^1$  relatively small.  $m^2$  equal to about  $\frac{2}{3}$  or  $\frac{3}{4}$  the area of  $m^1$ . Forearm 39–44 mm.

*Skull*.—Not differing in shape from that of *A. glaucus* and *watsoni*; also the linear dimensions are, in every respect, very nearly the same as in those species.

*Teeth* (text-fig. 54).—The teeth bear still more decisive evidence of the very close relationship between *A. cinereus* and *A. glaucus* and *watsoni*. As in these latter, cusp 7 of  $m^1$  is relatively small,

Text-fig. 54.



*Artibeus cinereus cinereus*, ♂ ad. Para. B.M. 1.7.19.3.

Right upper tooth-row (note small cusp 7 of  $m^1$ ).  $\times \frac{1}{4}$ .

equal to from one ninth to one seventh the bulk of the whole tooth; at least on average it is, no doubt, a trifle more developed than in *glaucus* and *watsoni*, but not nearly as in *toltecus* and *aztecus*.—The teeth differ only in the following points, of minor importance:—

$m_3$  (rudimentary in *glaucus* and *watsoni*) has completely disappeared; 16 skulls, representing both of the races of *A. cinereus*

\* U.S. N. M. no. 51544.

recognised in this paper, have been examined, in none of them is  $m_3$ , or any trace of its alveolus, present.—The heel of  $p^1$  is a trifle larger than in *glaucus* and *watsoni*, but the difference is so small as only to be ascertained on very close comparison of the teeth. The small increase in the size of the heel of  $p^1$  corresponds to the small increase (on average) mentioned above in the size of the “heel” (cusp 7) of  $m^1$ .

As in *glaucus* and *watsoni* there is only a very faint trace (or, often, no indication at all) of a notch in the hinder margin of  $m^2$ , between its cusps 5 and 7.

*Tragus*.—2, 3, or 4 serrations on the outer margin above the median projection, always small, sometimes rather sharply defined, sometimes so obsolete that their number cannot be counted with certainty.

*Nose-leaves*.—The margin of the horseshoe is free all round, simple or finely crenulate.

*Wings*.—The peculiarities in the wing-structure described above in *A. glaucus* and *watsoni* (p. 287) are also found in their closest relative *A. cinereus*; as in the former species the second phalanx of the third digit is not fully  $1\frac{1}{2}$  the length of the first. The only appreciable difference is a slight lengthening of the metacarpals and of the phalanges of the fourth and fifth digits; by this modification the wings have become on the whole slightly longer and, because the increase falls chiefly on the fourth and fifth digits, somewhat broader than in *glaucus* and *watsoni*. See the wing-indices, below p. 310.

*Hairing on limbs and membranes*.—As in *A. glaucus* and *watsoni* (above p. 287).

*Colour*.—There is no difference in colour between the two geographical races of *A. cinereus*. The only skin available of a young (not full-grown) individual is very dark-coloured, almost precisely as young individuals of *A. jamaicensis*. Some of the adult specimens with unworn teeth come extremely near in colour to this young one, while the majority are a shade lighter, being quite indistinguishable in colour from *A. watsoni*; a few specimens are washed with drab-brown on the upper side; none are as light as the light-coloured stage of *A. watsoni* described above (p. 290).

Young, nearly full-grown (San Julian, Venezuela; U.S. N. M. 105432; *A. c. bogotensis*):—Upper side from the shoulders backward dark smoky brown, almost blackish brown, this colour confined to the tips of the hairs; base of hairs slate. On the anterior part of the upper side, from the shoulder region forward, the hair-bases are considerably lighter, nearly smoke-grey. Under side dark grey, approaching hair-brown. White supraorbital and infraorbital stripes strong. Ear-conch narrowly margined with white. No light tips to the wings.

A majority of adult individuals, teeth unworn or worn (both races):—Precisely as the darker stage of *A. watsoni* (p. 289).

Two adults (Kanuku Mts., Guiana; and Merida, Venezuela; teeth unworn; *A. c. cinereus*):—Upper side washed with drab-



brown; hair-bases on the hinder back light greyish drab, on the neck ecru-drab. Under side drab. Facial stripes strong. Narrow white edgings to the ears. No light tips to the wings.—These are the lightest coloured individuals I have seen; very likely a still lighter phase occurs, similar to that of *A. watsoni* (p. 290).

*Range*.—Northern part of S. America: Para, Guiana, Venezuela (including Trinidad), Colombia.

*Remarks*.—This species cannot be discriminated with certainty from *A. glaucus* and *watsoni* without an examination of the teeth (a rudimentary m<sub>3</sub> present in *glaucus* and *watsoni*, wanting in *cinereus*).

Two geographical races are separable, differing only in size. The one, *A. c. cinereus*, has probably its centre of distribution in Guiana, having spread southward at least to Para, northward to N.W. Venezuela; the other, *A. c. bogotensis*, seems to have its centre in Colombia, having spread northward to N.W. Venezuela, where consequently both forms meet.

#### ARTIBEUS CINEREUS CINEREUS Gervais.

*Stenoderma cinereum* Blainville, MS. label in Paris Museum (*fide* Gervais, l. i. c.).

1856. *Dermanura cinereum* Gervais, Exp. Castelnau, Mamm. 2<sup>e</sup> Mém. livr. 15, sheet 5\*, p. 36; pl. viii. figs. 4, 4a; pl. ix. figs. 4, 4a; pl. xi. fig. 3.—Type locality: "Brésil."  
 1901. *Artibeus cinereus* Gerv., Thomas, Ann. & Mag. N. H. (7) viii. p. 143 (Aug. 1901).—Kanuku Mts.  
 1901. *Artibeus cinereus* Gerv., Thomas, Ann. & Mus. N. H. (7) viii. p. 192 (Sept. 1901).—Para.

*Diagnosis*.—Teeth, skull, and external dimensions averaging smaller. Forearm 39–42 mm.

*A. c. cinereus* and *bogotensis*.—There is only an average difference between the eastern form of *A. cinereus* here under consideration and the western form of the same species described below (*A. c. bogotensis*). The skull, in *A. c. cinereus*, is on the whole slightly narrower, the maxillary width ranging between 8 and 8.6 mm. (average 8.3 mm.), in *A. c. bogotensis* between 8.5 and 8.9 mm. (average 8.6 mm.). The teeth are slightly smaller; the length of the upper tooth-row varies between 6.4 and 6.8 mm. (average 6.7 mm.), in *A. c. bogotensis* between 6.7 and 7.2 mm. (average 6.9 mm.). The forearm and metacarpals average 2.2–3.5 mm. shorter.

*Measurements*.—On p. 295.

*Specimens examined*.—10 specimens (4 skins) and 8 skulls, from the following localities:—

British Museum:—Para (1). Kanuku Mts., British Guiana, about 59° W., 3° N. (4). Trinidad (1). Merida, Venezuela (2). N.W. Venezuela (1).—7 skulls, representing all these localities.

\* The title-page of the volume is dated 1855; on the probable dates of publication of the livraisons see C. Davies Sherborn and B. B. Woodward, Ann. & Mag. N. H. (7) viii. p. 164 (Aug. 1901).

U.S. National Museum\*:—Merida, Venezuela (1), with skull.

*Range*.—Guiana, southward at least to Para, northward to N.W. Venezuela, including the island of Trinidad.—In N.W. Venezuela it meets *A. c. bogotensis*; in this region the two races apparently merge into one another.

Gervais's *Artibeus cinereus*, 1856.—Type locality: Brazil.—Notwithstanding the rather defective description there cannot be much doubt as to the identification of Gervais's specimen; it is a small *Artibeus* with  $\frac{2}{3}$  molars, a small cusp 7 of  $m^1$  (see Pl. ix. fig. 4), and the locality is, as mentioned, "Brésil." The combination of the habitat and the two characters quoted exclude all other known species of the genus. The coloured figure on Pl. ix., stated to be of natural size, is about 16 p. ct. too large in linear dimensions (compare the measurements of the forearm and tibia as given by Gervais); the metacarpals and phalanges are very carelessly drawn.

#### ARTIBEUS CINEREUS BOGOTENSIS K. And.

1880. ? "*Artibeus quadrivittatus* Pet.," Dobson, P. Z. S. p. 465.—Popayan, N. Colombia (Paris Museum; specimen not examined).

1901. *Dermanura quadrivittatum* (not Peters) Robinson & Lyon, Proc. U.S. Nat. Mus. xxiv. (no. 1246) p. 510.—San Julian, Venezuela (only specimens W.R. 1586 and 1617 examined).

1906. *Artibeus cinereus bogotensis* Knud Andersen, Ann. & Mag. N. H. (7) xviii. p. 421 (Dec. 1906).—Type locality: Curiche, nr. Bogota, Colombia.

*Diagnosis*.—Similar to *A. c. cinereus*, but teeth, skull, and external dimensions averaging larger. Forearm 41.2–44 mm.

*A. c. bogotensis* and *cinereus*.—The differences between this form and its eastern representative, *A. c. cinereus*, have been pointed out above, p. 292.

*Measurements*.—On p. 295.

*Specimens examined*.—9 specimens (8 skins) with skulls, from the following localities:—

British Museum:—Colombia: Bogota region, various localities (5). N.W. Venezuela (1).

U.S. National Museum†:—San Julian, 8 miles east of La Guaira, Venezuela (2). Merida, Venezuela (1).

*Range*.—From Central Colombia to N.W. Venezuela, where it meets *A. c. cinereus*. In the latter region the two races apparently merge into one another.

#### ARTIBEUS ROSENBERGI THOS.

1897. *Artibeus* (*Dermanura*?) *rosenbergi* Thomas, Ann. & Mag. N. H. (6) xi. pp. 545–46 (Dec. 1897).—Type locality: Cachavi, N. Ecuador.

*Diagnosis*.—Molars  $\frac{2}{3}$ . Cusp 7 of  $m^1$  small,  $m^2$  equal to about  $\frac{1}{3}$  the area of  $m^1$ . Forearm 37.8–39.8 mm.

*Skull*.—Very similar in shape to that of *A. watsoni* and *A. cinereus cinereus*.

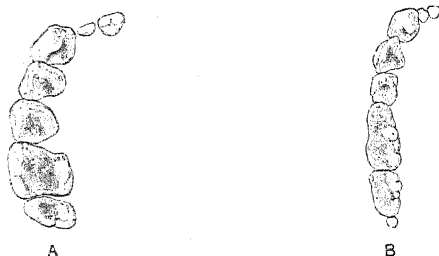
*Teeth* (text-fig. 55).—Different from those of any other species of

\* U.S. N. M. no. 123348.

† U.S. N. M. nos. 105432–33 (nos. W.R. 1586 and 1617), 123344.

*Artibeus*, chiefly in the strong reduction in the size of  $m^2$ .  $m^1$  not essentially different from that of *A. watsoni*; cusp 7, if anything, still less developed, represented only by a narrow, slightly projecting shelf, therefore as narrow as in any *Vampyrops*, its basal outline almost perfectly quadrate.  $m^2$  little more than  $\frac{1}{3}$  (in all other species of the genus  $\frac{2}{3}$  or  $\frac{3}{4}$ ) the area of  $m^1$ , but all the elements of the tooth (cusps 4, 5, 6, 7) are distinct, and all of them have been very nearly equally reduced in size, though perhaps cusp 7 a little more than the others.

Text-fig. 55.



*Artibeus rosenbergi*, ♂ ad. Cachavi, N. Ecuador. Type, B.M. 97.11.7.76.

Right upper (A), left lower tooth-row (B).  $\times \frac{1}{4}$ .

On  $m_3$  in this species see text below.

The lower  $m_2$  is proportionally a little smaller than usual in the genus, but by no means reduced to the same degree as  $m^2$ ; the area of  $m_2$  is about  $\frac{2}{3}$  (in other species about  $\frac{3}{4}$ ) that of  $m_1$ . In the type specimen of *A. rosenbergi* an excessively small  $m_3$  is present on the left side, entirely wanting on the right side; the normal condition is no doubt that  $m_3$  is wanting. In the material sent for identification from the U.S. National Museum I find a second specimen of *A. rosenbergi* (no. 62635), in which there is no trace of  $m_3$ ; and in *A. toltecus*, which has  $\frac{2}{3}$  molars, one skull, out of 27, has an  $m_3$  on one side of the mandible, thus showing an individual anomaly apparently perfectly like that of the type skull of *A. rosenbergi*.

*Tragus and horseshoe*.—The tragus has one or two serrations on the outer margin above the median projection. The horseshoe is free all round, the margin simple or finely crenulate.

*Wings*.—The most noteworthy peculiarity in the wing-structure is a conspicuous lengthening of the metacarpals; the phalanges are very nearly of the same relative length as in *A. glaucus* and *watsoni*, the first phalanx of the third digit perhaps not quite as long as in those species. See the wing-indices, p. 310.

*Hairing on limbs and membranes*.—Essentially as in the nearest relatives, *A. glaucus*, *watsoni*, and *cinereus*. Above, the proximal half of the forearm densely haired; a tuft of short hairs on first metacarpal; femur, tibia, foot to the claws, and interfemoral

to its posterior margin covered with rather short and sparse hairs. Below, the hairing on the interfemoral chiefly confined to its median portion and posterior margin.

*Colour* (of the type specimen, an adult male with slightly worn teeth, preserved in alcohol):—Brownish drab above, base of hairs much lighter; under side greyish drab. White facial stripes strong. No white margins to the ears, no white tips to the wings.

*Measurements*.—See table below.

*Specimens examined*.—Two specimens (in alcohol) with skulls, viz., one from Cachavi, N. Ecuador (British Museum, the type), and one from La Guaira, Venezuela (U.S. National Museum\*).

*Measurements of Artibeus cinereus and rosenbergi.*

	<i>A. cinereus.</i>						<i>A. rosenbergi.</i>	
	<i>cinereus.</i>			<i>bogotensis.</i>				
	10 adults, 8 skulls.			8 adults, 8 skulls.			2 adults, 2 skulls.	
	MIN.	MAX.	MED.	MIN.	MAX.	MED.	MIN.	MAX.
Skull, total length to front of c	mm. 19.8	mm. 21	mm. 20.3	mm. 20.2	mm. 21	mm. 20.8	mm. 20.7	mm. 20.7
" mastoid width	10	10.5	10.3	10.8	11	10.9	10.2	10.8
" width of brain-case	9	9.3	9.1	9.2	9.6	9.3	8.8	9.7
" zygomatic width	11.3	12.2	11.9	11.8	12.7	12.3	11.5	11.8
" maxillary width across m <sup>1</sup>	8	8.6	8.3	8.5	8.9	8.6	8.2	8.2
" across cingula of canines	5.6	5.8	5.7	5.6	6	5.8	6	6
Mandible, to front of incisors	12.8	13.7	13.1	13	14	13.6	13.3	13.3
Upper teeth, c-m <sup>2</sup>	6.4	6.8	6.7	6.7	7.2	6.9	6.8	6.8
Lower teeth, c-m <sub>2</sub>	6.8	7	6.9	6.8	7.3	7.1	7	7.2
Ear-conch, length, inner margin	11.5	12.2	11.9	...	12	...	11	12
" length, outer margin	15.7	17	16.2	...	16.5	...	15	...
" width	11.3	12.3	11.9	...	12	...	11	11.8
Tragus, length	5	6	5.8	...	6	...	5.8	...
Lancet, length	8.2	9.2	8.9	...	8.8	...	8	8.8
" width	5.2	6	5.5	...	6	...	5.5	6
Horseshoe, width	6	6.6	6.3	...	6.8	...	6	6.2
Forearm	39	42	40.3	41.2	44	42.5	37.8	39.8
Pollex	10	10.5	10.2	10	11.8	10.8	9.8	10.2
3rd metacarpal	35.5	37	36.3	38.5	41.3	39.4	35.3	37.5
III <sup>1</sup>	13.2	14.8	14.4	14.8	16	15.3	12.8	13.5
III <sup>2</sup>	18.3	22	20.5	21	22.8	21.7	19.8	19.8
III <sup>3</sup>	10.2	11.2	10.7	10.7	12	11.3	9.8	10.8
4th metacarpal	34.7	36.2	35.5	37.5	40.7	38.6	34.2	36.2
IV <sup>1</sup>	12	12.8	12.3	12	13.7	12.9	11.2	11.2
IV <sup>2</sup>	11.7	14.8	13.2	13.2	15	14	12.7	12.8
5th metacarpal	35.5	37.8	36.8	39.5	42	40.3	35.5	37.8
V <sup>1</sup>	9.2	10.2	9.6	9.8	11	10.2	8.5	8.7
V <sup>2</sup>	10	12	11.3	11.2	12	11.8	10	10.2
Interfemoral	9	11.2	10.3	...	12	...	9	11.5
Lower leg	13.5	15	14.1	14.8	15.7	15.1	13	14
Foot, with claws	9.2	10.2	9.8	10.3	11.5	10.9	9	10
Calcaneus	4.3	4.8	4.7	4.8	5	4.9	5	5

\* U.S. N. M. no. 62635.

*Range*.—The two specimens examined are the only known.

*Remark*.—*A. rosenbergi* cannot be discriminated, with certainty, by any external character from other species of *Artibeus* of similar size, f. i. *A. watsoni*, *cinereus* (*cinereus*), *toltecus*. But it is unique in the strong reduction of  $m^2$ .

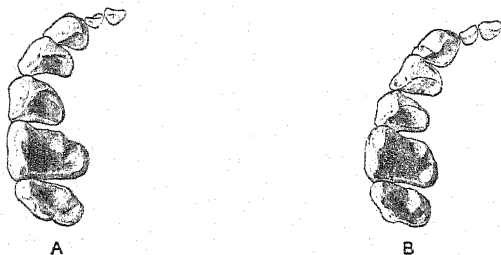
#### ARTIBEUS TOLTECUS Saussure.

*Diagnosis*.—Molars  $\frac{2}{3}$ . Cusp 7 of  $m^1$  large. Bony palate not shortened. Forearm 37.5–43.5 mm.

*A. toltecus* and *cinereus*.—*A. toltecus* cannot be discriminated with certainty by any external character from *A. cinereus*. The interfemoral in *A. toltecus* is probably, at least on average, markedly shorter, but of one of the races, *A. t. rarus*, only skins have been available for examination. The skull of *A. toltecus* is almost precisely, in shape as in dimensions, like that of *A. cinereus*, the only difference being a proportionately greater maxillary width in *A. toltecus*. The length of the tooth-rows is practically the same in both species.

Notwithstanding this close similarity, *A. toltecus* and *cinereus* are not only distinct species, but evidently representatives of two distinct sections of the genus. In *A. glaucus*, *watsoni*, and *cinereus* cusp 7 of  $m^1$  is proportionally small (text-fig. 56 B); in *A. toltecus* and *aztecus* (as well as in *A. quadrivittatus*, *turpis*, and *nanus*) this cusp is largely developed, being equal to about  $\frac{1}{3}$  to  $\frac{1}{4}$  (in *glaucus*,

Text-fig. 56.



A. *Artibeus toltecus rarus*, ♂ ad. Corondelet, N.W. Ecuador. B.M. 1.6.5.3.

Right upper tooth-row (cusp 7 of  $m^1$  large).  $\times \frac{1}{4}$ .

B. *Artibeus cinereus cinereus*, ♂ ad. Para. B.M. 1.7.19.3.

Right upper tooth-row (cusp 7 of  $m^1$  small).  $\times \frac{1}{4}$ .

*watsoni*, and *cinereus* to about  $\frac{1}{3}$  to  $\frac{1}{4}$ ) of the whole tooth (text-fig. 56 A). Also cusp 7 of  $m^2$  is in *toltecus* and allied species larger and more distinctly projecting.—The larger cusp 7 of  $m^1$  (and  $m^2$ ) increases, of course, the breadth of this tooth; there cannot be much doubt that the proportionally slightly larger maxillary width of the skull of *toltecus* (and *aztecus*) mentioned above is a direct consequence of the slightly increased breadth of the molars.

The proportionate length of the bony palate is quite as in all the foregoing species of *Artibeus*, the distance from palation to the hinder margin of the incisive foramina being larger than the distance from palation to basion (compare *A. turpis* and *nanus*, characterised by a shortening of the bony palate, p. 307).

*A. toltecus* and *artecus*.—The difference between these two species is pointed out below, p. 306.

$m_3$  in *A. toltecus*.—In one skull, out of 27 examined,  $m_3$  is present on the right side, entirely wanting on the left; the individual is a young adult male of *A. t. rarus* (Brit. Mus. no. 1.6.5.6). In all the other skulls representing both races and different ages, from immature to very old,  $m_3$  and its alveoli are wanting.

*Wings*.—The wing-structure very closely resembles that of *A. cinereus*, the only appreciable difference being the slightly shorter proximal phalanges of the third, fourth, and fifth digits; in *A. cinereus* the indices of these phalanges are, respectively, 357, 304, and 239, in *A. toltecus* 342, 289, and 227. For further details see the wing-indices on p. 310.

*Hairing on limbs and membranes*.—As in *A. cinereus*, but the upper side of the interfemoral more strongly haired, the fur forming a distinct fringe along the posterior margin of the membrane.

*Colour*.—See *A. t. toltecus* (p. 298) and *A. t. rarus* (p. 300).

*Range*.—From N. Ecuador to Central Mexico (Durango), but Ecuador individuals (*A. t. rarus*) differ in some respects from Central American and Mexican individuals (*A. t. toltecus*).

#### ARTIBEUS TOLTECUS TOLTECUS SAUSSURE.

1860. *Stenoderma tolteca* H. de Saussure, Rev. & Mag. de Zool. (2) xii. pp. 427-28, pl. xv. fig. 4 (Oct. 1860).—Type locality: Mexico.

1878. *Artibeus cinereus* (not Gervais) Dobson, Cat. Chir. Brit. Mus. pp. 520-21.—Costa Rica, Guatemala, Mexico.

1882. *Artibeus cinereus* (not Gervais) Thomas, P. Z. S. p. 371.—Durango (Mexico).

*Diagnosis*.—Averaging larger: forearm 39-43.5 mm. Facial stripes and white edgings to the ears as a rule wanting or indistinct, rarely well developed.

*A. t. toltecus* and *rarus*.—*A. t. toltecus* can only be discriminated from *A. t. rarus* by average characters. The skull of *A. t. toltecus* averages in every respect a trifle larger (especially broader), but small skulls of *toltecus* are indistinguishable from large skulls of *rarus*. The external dimensions average larger, the forearm and metacarpals being from 2.7 to 3.2 mm. longer. As in *A. t. rarus* there is a dark and a light phase, but the dark phase in *A. t. toltecus* is noticeably darker than in any specimen I have seen of *A. t. rarus*. In most specimens of *A. t. rarus*, both in its dark and light phase, the facial stripes and light edgings to the ears are sharply pronounced; in *A. t. toltecus* they are but rarely well marked, as a rule indistinct or quite undeveloped.

From this it will be seen that it is impossible to draw a

definite line between *A. t. toltecus* and *ravus*; they are evidently a northern and southern representative of one species.

*Colour* (excluding facial stripes and ear-edgings).—Dark phase:—General colour of upper side very dark, approaching blackish brown (being, rather, a blackish shade of drab), this colour confined to the tips of the hairs; base of hairs drab in the posterior, almost ecru-drab in the anterior part of the upper side. Under side drab.—This is the extreme of the dark phase in adult specimens; it is rather more blackish than the dark phase of *A. watsoni* (p. 289).

Light phase:—In its extreme the light phase is indistinguishable from that of *A. t. ravus* (p. 300).

The dark and light phases are connected by numerous transitional stages, but a majority of the individuals examined are more or less dark-coloured.

*Facial stripes and ear-edgings*.—In a majority of adult individuals there is no trace of facial stripes nor of white edgings to the ears; but individuals occur in which these light markings are more or less distinct, and sometimes, though rarely, they are fully developed. The subjoined table will show the amount of variation in this respect in 17 adult individuals of *A. t. toltecus* examined, as well as the stronger development

*Facial stripes and ear-edgings of adult individuals of  
A. t. toltecus and ravus.*

	Locality.	Supraorbital stripes	Infraorbital stripes	White ear-edgings
<i>A. t. toltecus</i> ...	Costa Rica (1).	none.	none.	none.
	Nicaragua (1).	indistinct.	indistinct.	none.
	Guatemala (1).	none.	none.	none.
	Oaxaca (2).	none.	none.	none.
	Jalisco (9).	none (5). indistinct (2). distinct (1). strong (1).	none (5). indistinct (2). distinct (2). strong (0).	none (3). indistinct (4). distinct (2). strong (0).
	Vera Cruz (3).	none.	none.	none.
<i>A. t. toltecus</i> ...	All localities (17).	none (70 p. ct.). indistinct (18 p. ct.). distinct (6 p. ct.). strong (6 p. ct.).	none (70 p. ct.). indistinct (18 p. ct.). distinct (12 p. ct.). strong (0 p. ct.).	none (65 p. ct.). indistinct (23 p. ct.). distinct (12 p. ct.). strong (0 p. ct.).
<i>A. t. ravus</i> ...	All localities (11).	none (0). indistinct (18 p. ct.). distinct (36 p. ct.). strong (46 p. ct.).	none (0). indistinct (27 p. ct.). distinct (36 p. ct.). strong (37 p. ct.).	none (0). indistinct (0). distinct (27 p. ct.). strong (73 p. ct.).

and apparently much greater constancy of these markings in the southern race, *A. t. rarus*. It is a rather strange fact that, so far as the facial markings are concerned, there is much the same difference between the northern and southern races of *A. toltecus* as between the northern and southern races of *A. jamaicensis*; also in this latter species the facial stripes are stronger and more constant in the southern forms.

*Specimens from different localities.*—Central American are in every respect indistinguishable from Mexican individuals. The comparative table of measurements below, in which I have arranged the adult individuals examined in four sections according to their habitat, shows this as far as the cranial and external dimensions are concerned.

*Measurements of A. toltecus toltecus.*

	Costa Rica, Nicaragua, Guatemala.		Oaxaca.		Jalisco, Durango.		Vera Cruz.	
	3 adults, 3 skulls.		2 adults, 1 skull.		9 adults, 5 skulls.		3 adults, 3 skulls.	
	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
Skull, total length to front of e	20.5	21	20.6		20.2	21.2	20.8	21.2
„ mastoid width	11	11.5	11		10.7	11.4	11	11.5
„ width of brain-case	9.8	10	9.5		9.5	10.2	9.6	10
„ zygomatic width	12.2	12.7	12.3		12.3	13	12.7	13
„ maxillary width across m <sup>1</sup>	9.2	9.8	9.2		9	9.2	9.5	9.8
„ across cingula of canines	6	6.1	6		5.7	6.2	5.8	6
Mandible, to front of incisors	13.2	14	13.4		13.2	14.2	13.8	14
Upper teeth, c-m <sup>2</sup>	6.8	7.2	6.8		6.8	7	7	7.1
Lower teeth, c-m <sub>2</sub>	7	7.4	7		7	7.2	7.2	7.3
Ear-conch, length, inner margin	11.3	11.8	11	12	12	12.7	12.2	12.5
„ length, outer margin	15.8		15.5	15.8	16.2	18	16.8	
„ width	12	12.2	11.8	12.8	12	13.5	12	13.5
Tragus, length	6		6		6	6.5	.....	
Lancet, length	8.8	9.5	8.5		8.8	9.5	9.7	9.8
„ width	6		.....		5.5	6.2	6	6.6
Horseshoe, width	6.3	6.5	5.8	5.8	6.2	7.2	6.6	7
Forearm	39.8	42	39	39.8	29	42.5	39.2	43.5
Pollex	10	10.2	10.6	11.4	10	11.8	10	12
3rd metacarpal	37.8	39	36.8	38	35.8	39.8	37	40.5
III <sup>1</sup>	13.5	14.2	12.5	13.2	13	14.7	13	15
III <sup>2</sup>	20	21	19.8	21	19.2	22	20.2	23.8
III <sup>3</sup>	10.5	11	10	11.8	10	12	10.2	12.8
4th metacarpal	36.2	38	35	36.8	35	39	36.2	39
IV <sup>1</sup>	11.3	12	11	11.8	11	12.8	11.2	12.5
IV <sup>2</sup>	13	14	13	14	12.7	14.3	12.7	14.8
5th metacarpal	37.8	39.3	36.8	37.2	36.8	40.2	37	40.8
V <sup>1</sup>	9	9.8	8.7	9	8.2	9.8	8.8	10
V <sup>2</sup>	11	11.2	10.2	11.3	10.2	11.8	10	12.2
Interfemoral	7	8.5	6.5	7.5	5	10.5	8	9.8
Lower leg	14.5	15	.....		14	16	13.8	15.7
Foot, with claws	10	10	.....		10	11.8	11	11.7
Calcar	4.2	4.3	4.2		4.2	5.7	4.5	4.8



*Specimens examined*.—24 specimens (3 skins), 15 skulls, from the following localities:—

British Museum:—Costa Rica (2). Nicaragua: Jinotega, 1100 m. (1). Guatemala: San Geronimo (1). Jalisco: Amba Aguas, Tepic (2). Durango: Ventanas (2 juv.). "Mexico" (1). Uncertain locality (1).—7 skulls, from all the localities represented by adult specimens.

U.S. National Museum\*:—Oaxaca: Juquila (2). Jalisco: Plantinar (7), Teuchitlan (1). Vera Cruz: Mirador (3). Uncertain locality (1).—8 skulls, from all these localities.

*Range*.—Central America, S. and Central Mexico, as far north as Durango.

Saussure's *Stenoderma toltecum*, 1860.—The essence of the original description is this:—*S. toltecum* is an *Artibeus*, with  $\frac{2}{2}$  molars, very short interfemoral (4.5 mm.), the forearm measuring 41 mm., and inhabiting Mexico. The  $\frac{2}{2}$  molars exclude all Mexican species of the genus except *A. toltecus*, *phacotis*, *aztecus*, *turpis*, and *nanus*. Of these, *A. phacotis* and *nanus* are excluded by their small size, *A. aztecus* by its larger size, *A. turpis* by its longer interfemoral; leaving only the species here called *A. toltecus*, and, from the locality (Mexico), the race *A. t. toltecus*.

*Artibeus cinereus* in Dobson's *Catalogue*, 1878.—I have examined the four specimens catalogued by Dobson (*l. s. c.*) as *Artibeus cinereus*; all of them are *A. toltecus toltecus*.

#### ARTIBEUS TOLTECUS RAVUS Miller.

1902. *Dermanura rava* Gerrit S. Miller, Jr., Proc. Acad. N. Sci. Philad. p. 404 (12 Sept. 1902).—Type locality: San Javier, N. Ecuador.

*Diagnosis*.—Similar to *A. t. toltecus*, but facial stripes as a rule distinct or strong, and white edgings to the ears always distinct; general size averaging smaller: forearm 37.5–39.7 mm.

*A. t. rarus* and *toltecus*.—The differences between these two forms have been pointed out in detail above, under the description of *A. t. toltecus* (pp. 297–299).

*Colour*.—Adult individuals show a darker and lighter phase, closely resembling those of *A. watsoni*:—

Darker phase: one skin, fully adult, teeth slightly worn (Brit. Mus. no. 1.6.5.5.):—Upper side as in darker-coloured individuals of *A. watsoni* (see p. 289). Under side distinctly darker than in *A. watsoni*, almost broccoli-brown. Facial stripes strong. Whitish ear-edgings very distinct. No light tips to the wings.

Lighter phase: eight skins, fully adult, teeth slightly worn, well worn, or much worn:—Precisely as in light-coloured individuals of *A. watsoni* (p. 290). Facial stripes as a rule strong, or at least distinct, sometimes indistinct, in none completely

\* U.S. N. M. nos. 5203, 6879, 6881, 11216, 52082, 52085, 52087–89, 52095–96, 52098, 76512, 76515.

wanting (see table, p. 298). Whitish ear-edgings strong, or at least distinct. No light tips to the wings.—The shade of colour is not quite the same in all of the eight skins; some of them evidently show traces of a darker stage, but none are truly intermediate.

*Measurements*.—On p. 309.

*Specimens examined*.—12 skins, with skulls, from the following localities:—

British Museum:—N. Ecuador: Pambilar (3); Corondelet (5).

U.S. National Museum\*:—N. Ecuador: Pambilar (2); Corondelet (2); all specimens paratypes of "*Dermanura rava*."

*Range*.—As yet only known from N. Ecuador.

Miller's *Dermanura rava*, 1902.—Type locality: San Javier, N. Ecuador.—Miller compared *D. rava* with *D. cinerea* (i. e. probably Dobson's description of *A. cinereus*, which, however, is taken from examples of *A. t. toltecus*) and *D. tolteca* (i. e. *A. aztecus* of the present paper; I have seen the actual specimen referred to by Miller, U.S. N. M. no. 52051), and found it differing in the following particulars: smaller, the "colour much paler," "the palatine foramina much more numerous," and persisting "as two conspicuous rows of small perforations even in very old individuals."—The type was collected by G. Fleming; all the British Museum examples are from the same collector and practically the same locality; and by the kindness of Mr. Miller and the Authorities of the U.S. National Museum I have had for examination four of his paratypes, so that all doubt as to the identification of *D. rava* is excluded.

Miller apparently laid much stress on the pale colour of *A. t. rava*, and the four specimens sent from the Washington Museum are, in fact, all light-coloured; but the British Museum series shows that also a dark phase occurs in perfectly adult individuals. Of twelve skins examined, three must be put aside as being either immature or young adults; of the remaining nine, one represents the dark phase, eight the light. Taking in consideration that the specimens were obtained in three different places in N. Ecuador (between August 10th and October 26th), viz., San Javier, Corondelet, and Pambilar, there seems to be some reason for supposing that this strong preponderance of light-coloured individuals is not quite accidental; it may be that a majority of adult individuals of this form are light-coloured. It has been mentioned above (p. 299) that so far as the development of the facial stripes is concerned, there is much the same difference between the northern *A. t. toltecus* and the southern *A. t. rava* as between the northern and southern races of *A. jamaicensis*; if it proves true that a majority of individuals of *A. t. rava* are light-coloured, there is another parallelism to *A. jamaicensis*; as pointed out above (p. 256) 77 p. et. of individuals of the southern races of *jamaicensis* are light coloured, as against only

\* U.S. N. M. nos. 113333-34, 113337, 113339.

25 p. ct. in the northern races. But even if this be so, there is at all events no absolute difference in this respect between *A. t. rarus* and the true *A. t. toltecus*, in which latter dichromatism also occurs (see above p. 298). As to the number and persistency of the small palatine perforations, it is a character of no diagnostic value; it varies from individual to individual quite as much as it does from species to species.

#### ARTIBEUS QUADRIVITTATUS Pet.

1865. *Artibeus (Dermanura) quadrivittatus* Peters, MB. Akad. Berlin (13 July, 1865) p. 358.—Type locality: Surinam.  
 1878. *Artibeus quadrivittatus* Pet., Dobson, Cat. Chir. Brit. Mus. p. 521.—Surinam; Pernambuco.  
 1888. *Artibeus quadrivittatus* Pet., Jentink, Cat. Syst. Mamm. p. 209.—Surinam (type specimen).

*Diagnosis*.—Similar to *A. toltecus*, but upper side of interfemoral and tibia more sparsely haired, and interfemoral averaging somewhat longer. Forearm 41·7–44 mm.

*A. quadrivittatus* and *toltecus*.—In the shape and size of the skull, in the structure, number, and size of the teeth, and in all external characters, *A. quadrivittatus* is similar to *A. toltecus*, with these two exceptions:—First, in *A. toltecus* the upper side of the interfemoral and tibia is densely haired; in *A. quadrivittatus* the hairs are so short and sparse as to make the interfemoral membrane appear almost naked. Second, in the single alcoholic specimen examined of *A. quadrivittatus* the interfemoral measures, in the middle line, 12·3 mm., whereas the maximum found in a series of *A. t. toltecus* is 10·5 mm.; it probably indicates that the interfemoral averages longer in *quadrivittatus*.

The three specimens (two skins) examined are not sufficiently well preserved for a detailed description of the colours; in one the facial stripes are strong, in the others rather indistinct.

*Measurements*.—On p. 309.

*Specimens examined*.—Surinam (one, with skull); Pernambuco (two, with skulls); from the collection of the British Museum.

Peters's *Artibeus (Dermanura) quadrivittatus*, 1865.—Type locality: Surinam; type in the Leyden Museum.—The essence of the short original description is this:—"Von der Grösse und dem Ansehen des *St. toltecum* Saussure, aber mit etwas breiterer und weniger behaarter Schenkelflughaut," and "mit vier weissen Längsbinden auf dem Kopfe." Forearm 40, tibia 14, interfemoral in middle line 9 mm.

From the above there can be no reasonable doubt as to the identification of *A. quadrivittatus*. Peters's measurement of the interfemoral, viz. 9 mm., if compared with the length of this membrane in a British Museum specimen, viz., 12·3 mm., seems to show (which indeed was to be expected) that in the length of the interfemoral there is only an average difference between *A. quadrivittatus* and *A. toltecus toltecus*; in a series of this latter I find it varying from between 5 and 10·5 mm. (average 7·9 mm.),

so that the only, apparently reliable, difference between the two species is the denser hairing of the interfemoral and tibia in *A. toltecus*.

Dobson's *Artibeus quadrivittatus*.—Dobson's description of *A. quadrivittatus* (l. s. c.) may be epitomised in the following four sentences:—First, it is "very similar to *A. cinereus* [i. e. *A. toltecus toltecus*], but the nose-leaf is narrower and not so abruptly narrowed at the summit"; Dobson gives as breadth of the nose-leaf in *A. quadrivittatus* 0".25, in "*A. cinereus*" 0".28, making a difference of only 0".02 or 0.5 mm.; considering the not inconspicuous variation in the breadth of the nose-leaf in all other species, it would, *a priori*, appear highly improbable that such a small difference would prove to be reliable; and as a matter of fact there is no difference at all in this respect between *A. t. toltecus* and *A. quadrivittatus*; in the former the lancet is 5.5–6.6 mm. broad, in the only alcoholic specimen I have seen of the latter (also examined by Dobson) 6 mm.; also the shape of the lancet is the same in the two species. Second, "interfemoral membrane much deeper"; this is only correct, if for "much" we substitute "on an average somewhat." Third, the upper surface of the interfemoral "thinly clothed with fine hairs,"; this is correct (but there is no corresponding character in Dobson's description of his *A. cinereus*). Fourth, "the head with four longitudinal, not very distinct, white streaks, arranged as in *A. perspicillatus* [i. e. *A. jamaicensis lituratus*]", whereas in his *A. cinereus* [*A. t. toltecus*] there are "no white streaks on the face"; but the character is (as might be expected) individually variable in both species (as it also is, more or less, in other forms of the genus); in *A. t. toltecus* the facial stripes are, as a rule, wanting or rather indistinct, but specimens occur in which they are well developed, and, on the other hand, of three examples of *A. quadrivittatus* two have the facial stripes rather indistinct, one strong.—This perusal of Dobson's description, based on the same material as examined by him, leads to the same result as emphasised above: there is, probably, an average difference in the length of the interfemoral, and an apparently well-marked difference in the hairing of this membrane and the tibia, but I am unable to find any other character by which these two extremely closely related species can be discriminated from each other.

#### ARTIBEUS PHÆOTIS Miller.

1902. *Dermanura phæotis* Gerrit S. Miller, Jr., Proc. Acad. N. Sci. Philad. p. 405 (12 Sept. 1902).—Type locality: Yucatan.  
 1906. ? *Dermanura jucundum* D. G. Elliot, Proc. Biol. Soc. Wash. xix. p. 50 (1 May, 1906).—Type locality: Vera Cruz.

*Diagnosis*.—Similar to *A. toltecus rarus*, but with somewhat shorter tooth-rows, and no whitish edgings to the ears. Forearm about 38 mm.; third metacarpal about 37 mm.

I have not seen this species, which was described by Miller  
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from a single example (skin and skull) obtained at Chichen Itza, Yucatan. The following notes are based partly on Miller's published account, but chiefly on more detailed information, photographs of the skull (upper, lateral, and lower views), camera lucida outlines of the molars and the profile of the skull, and measurements of skull and external dimensions kindly given me by Dr. Marcus W. Lyon, Jr., Washington.

*Skull*.—General shape quite as in *A. t. ravus*. Judging from photographs of the type skull of *phaeotis*, I am unable to see any appreciable difference from a series of skulls of *ravus*, but Miller, who in the original description of *phaeotis* compared its skull with that of *ravus*, found "the rostrum broader and flatter and the median backwardly extending portion of the bony palate wider."—The measurements, as taken by Dr. Lyon (see table below, p. 309), are practically quite as in *ravus*.

*Teeth*.—The teeth of the type are very much worn down, but from photographs (twice natural size) and camera lucida outlines of the molars it is quite clear that they accord with those of *A. toltecus*; cusp 7 of  $m^1$  is large, as in this latter species. The tooth-rows are somewhat shorter than in *A. t. ravus*: upper teeth,  $c-m^2$ , 6 mm., according to Dr. Lyon, as against 6.5–7 mm. in a series of *ravus*, measured by myself.

*Colour*.—Miller describes the colour of the fur as closely similar to that of *A. t. ravus*, but the ears are "much darker and without the whitish border." All the specimens of *ravus* I have seen have distinct or strong whitish edgings to the ears (see table above, p. 298).

*External dimensions*.—I am indebted to Dr. Lyon for measurements of the forearm, third digit, first phalanx of fourth digit, and first phalanx of fifth digit; they are much as in *A. t. ravus*, only the metacarpals would seem to be a trifle longer (see below, p. 309).

*Measurements*.—On p. 309.

*Material examined*.—Photographs of the type skull.

*Range*.—Yucatan; ? Vera Cruz (see below, p. 305, under "*Dermanura jucunda*").

*Remarks*.—From the available information it appears that *A. phaeotis* is very closely related to *A. t. ravus*, differing chiefly in the somewhat shorter tooth-rows and lack of white edgings to the ears.

A species of *Artibeus* described below (p. 308) under the name of *A. nanus*, has like *phaeotis*  $\frac{2}{3}$  molars and cusp 7 of  $m^1$  large; the forearm measures 36.5–38 mm. (in *phaeotis* 38), the upper tooth-row 5.8–6.1 mm. (in *phaeotis* 6); in other words, in the form and number of the teeth and, so far as the length of the forearm is concerned, also in external dimensions, the two species are alike; further, *nanus* is known from the Mexican States of Guerrero, Colima, Sinaloa, and Vera Cruz, *phaeotis* from Yucatan and, probably, Vera Cruz, so that the distribution of the species is, partly at least, the same. Some words are therefore necessary

to prevent a confusion of these two bats which, though similar in the points mentioned, are widely distinct species :—

The skull of *A. phaeotis* is probably of the *toltecus* pattern; in *A. nanus* (and its larger relative *A. turpis*) the rostrum is peculiarly flattened and slightly bent upwards; the profile of the *nanus* skull is therefore very different from that of the *phaeotis* skull. In *A. phaeotis* the proportionate length of the bony palate is quite as in *toltecus* and allied species: measured from palation to hinder border of incisive foramina, longer than, or at least equal to, distance from palation to basion; in *nanus* (and *turpis*) the palate is shortened: its length (palation to incisive foramina) shorter than the post-palatal portion, from palation to basion. The skull of *nanus* is, on the whole, distinctly smaller than that of *phaeotis*. All these differences have been confirmed by Dr. Lyon (in litt.), who kindly compared a skull of my *A. nanus* (U.S. N. M. no. 51765; Colima) with the type skull of Miller's *A. phaeotis*.—Also externally the two species, in spite of all similarity, are distinguishable: although the forearm in *phaeotis* appears to have the same length as in a large *nanus*, the metacarpals are conspicuously longer; third metacarpal 37.3 mm., against 32.2–35 mm. in a series of *nanus*; also the proximal phalanges are a little longer in *phaeotis*.

Elliot's *Dermanura jucunda*, 1906.—Type locality: Achotal, State of Vera Cruz, Mexico. Described from one example, with skull.—According to Elliot, it is “allied to *D. quadrivittatum* from South America, but is smaller, with a considerably smaller skull,” and “the nose behind the nose-leaf whitish”; supraorbital stripes “very conspicuous,” infraorbital stripes “very indistinct.”

Professor Elliot has kindly informed me that the distance from palation to the hinder border of the incisive foramina is slightly greater than the distance from palation to basion (thus quite as in the ordinary *Artibeus* skull, not as in *A. nanus* and *turpis*), and given me some measurements of the skull, teeth, and wing (see table p. 309). From these measurements it is evident that the size of the skull and teeth is precisely as in *A. phaeotis*. The forearm measures “41.8 mm.” (Elliot in litt.; not 43 mm. as stated in the published description), as against “37.9 mm.” (Lyon) in *phaeotis*, a discrepancy of 3.9 mm.; but Lyon has undoubtedly measured the forearm of *phaeotis* to the distal end of the radius (if not, the difference between the length of the forearm and the third metacarpal, respectively 37.9 and 37.3 mm., would certainly be greater), and if Elliot, on the other hand, has measured the forearm of *jucunda* to the front curve of the carpus, then the discrepancy is reduced to about 3 mm., a very reasonable amount of individual variation in an *Artibeus* of this size; further, it should be noticed that Elliot's measurement of the third metacarpal is exactly (to a fraction of a millimetre!) like that of *A. phaeotis*, viz. 37.3 mm., and also the length of the phalanges of the third, fourth, and fifth digits practically as in *phaeotis*.—The white patch behind the nose-leaf mentioned by

Elliot is of no importance as a specific character; it only means that the supraorbital stripes are fused together in front; the same is often the case in other species, whenever these stripes are strongly developed. The fur is described as "dusky brown," whereas the type specimen of *phacotis*, according to Miller, does not differ in colour from his series of *A. t. rarus*, and therefore probably is pale-coloured; but also this proves nothing about the distinctness of *D. jucunda*; dichromatism is the rule in the species of *Artibeus*.

In brief, neither in the original description of *D. jucunda* nor in the additional information given me by Professor Elliot, am I able to find a single character by which *D. jucunda* can be discriminated from *A. phacotis*. So long as it has not been proved that such characters exist, I must regard the former name as a synonym of the latter.

#### ARTIBEUS AZTECUS K. And.

1902. *Dermanura tolteca* (not Saussure) Gerrit S. Miller, Jr., Proc. Acad. N. Sci. Philad. p. 404, footnote (12 Sept. 1902).—Morelos, Mexico (specimen examined).

1906. *Artibeus aztecus* Knud Andersen, Ann. & Mag. N. H. (7) xviii. p. 422 (1 Dec. 1906).—Type locality: Tetela del Volcan, Morelos, Mexico.

*Diagnosis*.—Allied to *A. toltecus*, but in every respect somewhat larger; metacarpals unusually long; interfemoral strongly haired. Forearm 45–46.8 mm.

*A. aztecus* and *toltecus*.—*A. aztecus* has no closer known relative than *A. toltecus*. As in this latter species cusp 7 of  $m^1$  (and  $m^2$ ) is largely developed, the maxillary width of the skull proportionately large, the number of molars  $\frac{5}{2}$ . But the skull is in every respect slightly larger and more heavily built, the teeth a little larger. The external dimensions are greater; in the smallest available specimen of *A. aztecus* the forearm is 6 mm. longer than in the smallest *A. t. toltecus*, in the largest specimen 3.3 mm. longer than in the largest *A. t. toltecus*. The metacarpals are unusually lengthened; in *A. toltecus* the indices of the third, fourth, and fifth metacarpals are, respectively, 912, 898, and 923; in *A. aztecus* 946, 928, and 954; the first phalanx of the third digit is of the same length as in *A. toltecus*, but the second phalanx so much lengthened as to be more than  $1\frac{1}{2}$  the length of the first; also the second phalanx of the fourth digit is proportionately longer than in *A. toltecus* (compare wing-indices, on p. 310). All these modifications of the wing-structure make, of course, a proportionately longer wing; in *A. toltecus* the indices of the three principal digits are 2037, 1516, and 1419, in *A. aztecus* 2088, 1565, and 1442.

The interfemoral is very short (as in *A. toltecus*) and unusually strongly haired, as is also the upper side of the tibia.

*Colour*.—The general colour of the fur, in all the four specimens examined, is quite as in the dark-coloured phase of *A. t. toltecus* (above p. 298). Facial stripes very indistinct or completely

wanting. No light edgings to the ears. No light tips to the wings.

*Measurements.*—On p. 309.

*Specimens examined.*—Tetela del Volcan, Morelos, Mexico (4, with skulls); from the collection of the U.S. National Museum\*.

*Range.*—As yet only known from Morelos, Mexico.

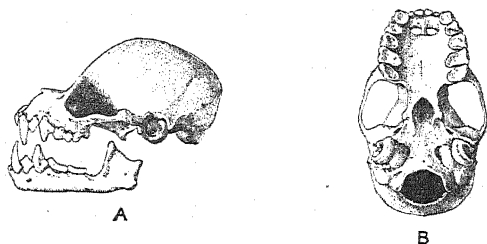
#### ARTIBEUS TURPIS K. And.

1906. *Artibeus turpis* Knud Andersen, Ann. & Mag. N. H. (7) xviii. p. 422 (1 Dec. 1906).—Type locality: Teapa, Tabasco, S. Mexico.

*Diagnosis.*—Molars  $\frac{2}{2}$ . Cusp 7 of  $m^1$  large. Rostrum of skull unusually depressed and distinctly bent upward; palate shortened. Larger than *A. nanus*: maxillary tooth-row 6.7 mm., forearm 40.5 mm.

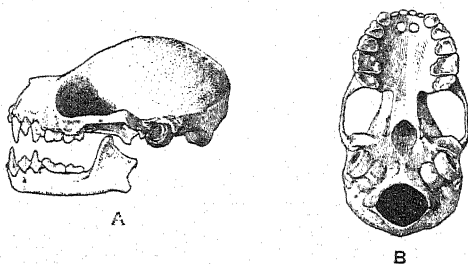
*Affinities.*—*A. turpis* and *nanus* (below, p. 308) are rather closely related to *A. toltecus* and *quadrivittatus*. As in these

Text-fig. 57.



A, B. *Artibeus nanus*, ♀ ad. Colima. U.S. N. M. 51785.  $\times \frac{3}{2}$ .

Text-fig. 58.



A, B. *Artibeus toltecus toltecus*, ♀ ad. Jalisco. U.S. N. M. 52038.  $\times \frac{3}{2}$ .

species, cusp 7 of  $m^1$  is large,  $m^3$  and  $m_2$  wanting, the rostrum conspicuously broadened. In some specimens of *A. t. toltecus*,

\* U.S. N. M. nos. 52050-51, 53769, 53772.



particularly in aged individuals, there is a tendency to flattening of the rostrum and vaulting of the brain-case; in *A. turpis* and *nanus* (text-fig. 57) this tendency has been carried to an extreme, and at the same time the rostrum is bent slightly upward; probably as a consequence of this latter, the bony palate has become shortened. These are the chief peculiarities of *A. turpis* and *nanus* as compared with *A. toltecus* and *quadrivittatus*.

*Skull* (compare text-fig. 57, of *A. nanus*).—Short and broad, as in *A. toltecus* and *quadrivittatus*. Rostrum more depressed and brain-case more vaulted than usual in the genus. Rostrum with a slight, but distinct, upward trend, the alveolar border of the maxillary bone, therefore, in profile more abruptly ascending; in *A. toltecus* (text-fig. 58) the profile of the nasal bones is slightly descending rather than horizontal, in *A. turpis* it is slightly ascending. Bony palate shortened; in *A. toltecus* (as in all the foregoing species of the genus, with exception of the short-faced *A. concolor*) the length of the palate, from palation to posterior border of incisive foramina, is *larger* than (extremely rarely almost equal to) the length of the post-palatal portion of the skull, from palation to basion; in *A. turpis* the bony palate is *shorter* than the post-palatal portion.

*Teeth*.—As in *A. toltecus* and *quadrivittatus*. Cusp 7 of  $m^1$  large; cusp 7 of  $m^2$  conspicuous, shelf-like, projecting.

In the nose-leaves, ears, wing-structure (see wing-indices, p. 310), and hairing on tibia and interfemoral, *A. turpis* does not differ appreciably from *A. toltecus*.

*Colour* (♀ ad., preserved in alcohol; teeth almost unworn; type of species).—General colour of upper side approaching Prout's brown, but with a distinct tinge of drab; base of hairs on hinder back almost wood-brown, on the neck and shoulder region ecru-drab; under side light wood-brown. Facial stripes strong. Narrow light margins to the ears. No white tips to the wings.—The general colour of this specimen has probably not remained quite uninfluenced by the preserving-fluid.

*Measurements*.—On p. 309.

*Specimens examined*.—One adult female, Teapa, Tabasco, S. Mexico; with skull; the type; British Museum.

*Range*.—As yet only known from the type specimen described above.

#### ARTIBEUS NANUS K. And.

1906. *Artibeus nanus* Knud Andersen, Ann. & Mag. N. H. (7) xviii. p. 423 (1 Dec. 1906).—Type locality: Tierra Colorada, Sierra Madre del Sur, Guerrero, Mexico.

*Diagnosis*.—Similar to *A. turpis*, but in every respect smaller. Maxillary tooth-row 5.8–6.1 mm.; forearm 36.5–38 mm.

*A. nanus* and *turpis*.—The chief peculiarities of *A. turpis* reoccur in *A. nanus*, if anything in a still more pronounced degree:—the depression and slightly ascending trend of the rostrum, the shortening of the bony palate, the high brain-case,

*Measurements of Artibeus toltecus, phaeotis, aztecus, turpis, and nanus.*

	<i>A. toltecus toltecus.</i>		<i>A. toltecus rarus.</i>		<i>A. quadrivittatus.</i>		<i>A. phaeotis.</i>		<i>A. aztecus.</i>	<i>A. turpis.</i>	<i>A. nanus.</i>
	18 adults, 13 skulls.	MIN. MAX. MED. mm. mm. mm.	11 adults, 11 skulls.	MIN. MAX. MED. mm. mm. mm.	3 adults, 3 skulls.	MIN. MAX. mm. mm.	Type of <i>phaeotis.</i> (Lyon in litt.)	Type of <i>phaeotis.</i> (filliot in litt.)	4 adults, 4 skulls.	♀ ad. Type.	8 adults, 5 skulls.
Skull, total length to front of c	20-2	21-2 20-8	19-3	20-6 19-9	20-5	20-5	mm.	mm.	22	22-8	MIN. MAX. MED. mm. mm. mm.
" mastoid width	10-7	11-5 11-1	10	10-8 10-4	10-8	10-2	10-2	10-3	11-4	11-8	18-2 18-7 18-5
" width of brain-case	9-5	10-2 9-8	8-8	9-5 9-1	9-6	9-7	10-2	10	10-6	10-6	9-8 9-8 9-8
" zygomatic width	12-2	13 12-6	11-2	12 11-8	12-2	12-8	11-8	11-6	11-6	12	8-8 9-1 9
" maxillary width across m <sup>1</sup>	9	9-8 9-3	8-3	8-8 8-6	8-8	9-2	8-2	8-1	9-3	9-8	11-5 11-7
" maxillary width of canines	5-7	6-2 5-9	5-5	6 5-8	5-8	6-2	8-2	8-1	6	6-1	8-2 8-5 8-3
Mandible, to front of incisors	13-2	14-2 13-7	12-0	13-7 13-1	13-7	14-1	12-3	12-4	14-7	15	5 5-4 5-2
Upper teeth, c-m <sup>2</sup>	7	7-4 7-1	6-5	7 6-8	7-1	7-2	6	6-5 *	7-5	7-6	5-5 5-4 5-2
Lower teeth, c-m <sup>2</sup>	11	13 12-2	.....	.....	12-2	.....	.....	.....	14-7	15	11-8 12-2 12
Ear-conch, length, inner margin	15-5	18 16-6	.....	.....	16-8	.....	.....	.....	12-8	13-2	11 12-5 11-8
" length, outer margin	11-8	14 12-7	.....	.....	12	.....	.....	.....	18	18	14 17 15-8
" width	6	6-5 6-3	.....	.....	5-8	.....	.....	.....	13	13-2	10-5 12 11-4
Tragus, length	8-5	9-8 9-2	.....	.....	9	.....	.....	.....	8-5	9-2	6-5 6 6-7
Lancet, length	5-5	6-6 5-9	.....	.....	6	.....	.....	.....	5-2	6-3	7-8 8-7 8-2
" width	5-8	7-2 6-5	.....	.....	6	.....	.....	.....	5-2	6-3	5 5-2 5-5
Horseshoe, width	39	43-5 41-9	37-5	39-7 38-7	41-7	44	37-9+	41-8	45	46-8	36-5 38 37-2
Forearm	10	12 10-7	9-2	11 10-4	.....	.....	.....	.....	11-3	12-5	9 10 9-4
Pollex	35-8	40-5 37-7	33	36 34-8	37-8	39-2	37-3	37-3	42	45	32-2 35 33-6
3rd metacarpal	12-5	15 13-7	12	14-7 13-6	14	14-5	13-7	13	15	16-3	12 12-7 12-7
III <sub>1</sub>	19-2	23-8 20-7	17-5	20-2 19-2	21-2	21-8	18	19-2	24	24-8	17-8 19-7 18-8
III <sub>2</sub>	10	12-8 11-1	9-2	11-8 10-5	11	.....	.....	.....	11-8	12-8	8-8 10-7 9-8
III <sub>3</sub>	25	30 37	32-8	36 34-2	36-8	38	.....	.....	41-7	44	37 31-5 34-8
4th metacarpal	11	12-8 11-7	11	12-2 11-5	12-2	12-8	11-8	11-7	12-8	13-7	10-3 11-3 10-9
IV <sub>1</sub>	12-7	14-8 13-6	11-5	13-2 12-3	13-3	.....	.....	.....	15-5	16-7	12 13 12
IV <sub>2</sub>	36-8	40-8 38-2	33-6	36-2 35-2	38	39	.....	.....	42-8	45	37 32 35-8
V <sub>1</sub>	8-2	10 9-1	8-6	10 9-1	9-2	10-2	.....	.....	10-8	10-8	8-2 9-5 8-9
V <sub>2</sub>	10-2	12-2 11	9-7	10-8 10-2	9-2	10-2	9-7	9-8	11-5	12-8	9-7 11 10-3
Interfenoval	5	10-5 7-9	.....	.....	11-8	.....	.....	.....	6	6-8	9-2 11-7 10-7
Lower leg	13-8	16 14-9	.....	.....	12-3	.....	.....	.....	10-3	17-2	13-2 14 13-8
Foot, with claws	10	11-8 10-8	.....	.....	14-7	.....	.....	.....	11-2	12-8	9-3 10 9-7
Calcari	4-2	5-7 4-8	4	4-2 4-1	4-2	.....	.....	.....	5-8	6	3-2 4-8 4-2

\* Estimated (m<sup>2</sup> lost).

† Probably measured to the distal end of the radius, not (as elsewhere in the present paper) to the front curve of the carpus.

the very broad skull (text-fig. 57 on p. 307); cusp 7 of  $m^1$  and  $m^2$  are relatively large, as in *A. toltecus*, *quadrivittatus* and *turpis*;  $m_3$  absent (five skulls examined); facial stripes strong. But *A. nanus* is conspicuously smaller than *A. turpis*; so far as my material goes, there seems to be a perfectly clear line of separation between the two species; in the *largest* example (among 12 specimens and 5 skulls) of *A. nanus* the skull is 1.3, the maxillary tooth-row 0.6, the forearm 2.5, and the third metacarpal 2 mm. shorter than in *A. turpis*. For further details see the table of measurements, p. 309.

*Colour* (adult skin; Buena Vista, Vera Cruz; U.S. N. M. no. 112791).—Upper side dark brown, with a tinge of drab; under side broccoli-brown. Facial stripes strong. Conspicuous light margins to the ears. No light tips to the wings.—A series of alcoholic specimens are noticeably lighter-coloured; in all the facial stripes are very distinct; the light ear-edgings sometimes obsolete.

*Specimens examined*.—12 specimens (one skin) and 5 skulls, from the following localities:—

British Museum:—Guerrero: Tierra Colorada, Sierra Madre del Sur (3). Sinaloa: Presidio, near Mazatlan (1).—3 skulls, representing both localities.

U.S. National Museum\*:—Colima: Hacienda Magdalena (7). Vera Cruz: Buena Vista (1).—2 skulls of adult specimens of the series from Colima (the skull of the single example from Vera Cruz has been lost).

*Range*.—Mexico, as far north as Sinaloa. Sinaloa is the most northern locality from which any species of *Artibeus* has been recorded.

*Remarks*.—The differences between *A. nanus* and *A. phaeotis* have been pointed out above, pp. 304–305.

### Wing-indices.

	Forearm.	3rd digit.				4th digit.			5th digit.		
		Mtc.	1 ph.	2 ph.	3 ph.	Mtc.	1 ph.	2 ph.	Mtc.	1 ph.	2 ph.
<i>U. bilobatum</i> and											
<i>thomasi</i> (25 specim.) <sup>1</sup> .....	1000	938	347	518	275	912	294	317	926	231	280
<i>A. planirostris</i> (85 specim.) ...	1000	903	297	483	262	883	260	324	905	197	244
<i>A. hirsutus</i> (8 specim.) .....	1000	887	281	481	261	868	245	313	891	186	231
<i>A. jamaicensis</i> (225 specim.)...	1000	900	298	492	259	884	259	318	913	201	245
<i>A. glaucus</i> and											
<i>watsoni</i> (10 specim.) .....	1000	897	354	510	264	884	296	317	920	224	261
<i>A. cinereus</i> (18 specim.) .....	1000	912	357	510	266	896	304	329	932	239	278
<i>A. toltecus</i> and											
<i>quadrivittatus</i> (32 specim.)...	1000	912	342	501	272	898	289	329	923	227	269
<i>A. aztecus</i> (4 specim.) .....	1000	946	342	532	268	928	288	349	954	222	266
<i>A. turpis</i> and											
<i>nanus</i> (9 specim.) .....	1000	903	341	505	263	890	293	323	914	240	277

\* U.S. N. M. nos. 51765–67, 51771, 51773–74, 51776, 112791.

*Summary of characters of Genera, Species, and Subspecies.*

- a. Skull long and slender; rostrum but very slightly depressed: height at  $p^1$  greater than, or equal to, width of skull at postorbital constriction; bony palate long: distance from palation to front of incisors about equal to zygomatic width; median backwardly extending portion of bony palate long, equal to combined length of  $m^1$  and  $m^2$ ; anterior nasal opening less oblique. Outer upper incisors bifid; cusp 2 of  $m_1$  small; molars  $\frac{3}{2}$ ;  $m^3$  larger (than in *Artibeus*), situated in row behind (not postero-internally to)  $m^2$ , almost as broad as hinder border of  $m^2$ ; cusp 5 of  $m^2$  situated near the labial margin of the tooth. A narrow line of whitish fur down the middle of the back .....
- URODERMA*, p. 212.
- a<sup>1</sup>. Length of skull (to front of c) 22-23.3 mm.; upper teeth (c- $m^3$ ) 7.5-8.5. Length of ear-conch (outer margin) 15.7-16.8; width of horseshoe 6.2-7.5. (S. Brazil and Peru to Costa Rica.) ...
- U. bilobatum*, p. 217.
- b<sup>1</sup>. Length of skull (to front of c) 24.7-24.8 mm.; upper teeth (c- $m^3$ ) 8.9-9. Length of ear-conch (outer margin) 18-18.5; width of horseshoe 7.8-8. (Bolivia.) .....
- U. thomasi*, p. 221.
- b. Skull short and broad; rostrum considerably depressed: height at  $p^1$  much less than width of skull at postorbital constriction; bony palate short: distance from palation to front of incisors much less than zygomatic width; median backwardly extending portion of bony palate short, much less than combined length of  $m^1$  and  $m^2$ ; anterior nasal opening more oblique. Outer upper incisors simple (not bifid); cusp 2 of  $m_1$  strongly developed, raised as a high slender cone near the middle of the lingual margin of  $m^1$ ; molars  $\frac{3}{2}$ ,  $\frac{3}{2}$ , or  $\frac{3}{2}$ . No white longitudinal dorsal stripe.
- c<sup>1</sup>. Median upper incisors simple (not bifid); molars  $\frac{3}{2}$ ;  $m^3$  and  $m_3$  larger ( $m_3$  equal to about  $\frac{1}{4}$  of  $m_2$ );  $m^3$  situated in row behind (not postero-internally to)  $m^2$ ; cusp 5 of  $m^2$  situated near the lateral margin of the tooth. Tragus with a pointed projection on inner margin near tip.....
- ENCHISTHENES*, p. 221.
- d<sup>1</sup>. Median upper incisors bifid; molars  $\frac{3}{2}$ ,  $\frac{3}{2}$ , or  $\frac{3}{2}$ ;  $m^3$  and  $m_3$  (when present) smaller ( $m^3$ , if not wanting, equal to  $\frac{1}{4}$ - $\frac{1}{2}$  of  $m_2$ );  $m^3$ , if not wanting, situated postero-internally to  $m^2$ ; cusp 5 of  $m^2$  moved lingually so as to occupy (precisely or nearly) the middle of the posterior margin of the tooth. No pointed projection on inner margin of tragus near tip .....
- ARTIBEUS*, p. 224.
- a<sup>2</sup>. Molars  $\frac{3}{2}$ .
- a<sup>3</sup>. Teeth small: upper row (c- $m^2$ ) about 7.2 mm. Rostrum shorter. Forearm 50 mm. (Guiana, Brazil.) .....
- A. concolor*, p. 232.
- b<sup>3</sup>. Teeth larger: upper row (c- $m^2$ ) 9.5-12 mm. Rostrum longer. Forearm 53.7-73 mm.
- a<sup>4</sup>. Tibia and distal part of interfemoral so short-haired as to appear almost naked; colour of fur of upper side not drab. Upper teeth (c- $m^2$ ) 9.8-12 mm.; forearm 55-73 mm. ....
- A. planirostris*, p. 234.
- a<sup>5</sup>. Smaller. Length of skull (to front of c) 27-30 mm.; zygomatic width 16.2-19.2; upper teeth (c- $m^2$ ) 9.8-11. Forearm 55-65.2.
- a<sup>6</sup>. Average length of skull (to front of c) 28.5 mm.; average zygomatic width 17.6. Average length of forearm 61.8. (Continental: Brazil to S. Mexico)...
- A. p. planirostris*, p. 237.

- b*<sup>6</sup>. Average length of skull 27·8 mm.; average zygomatic width 16·8. Average length of forearm 57·7. (Trinidad, Tobago.) ..... *A. p. trinitatis*, p. 241.
- c*<sup>6</sup>. Average length of skull 28·9 mm.; average zygomatic width 18. Average length of forearm 59·4. (Grenada.) ..... *A. p. grenadensis*, p. 241.
- b*<sup>5</sup>. Very large. Length of skull (to front of c) 29·5-33 mm.; zygomatic width 18·3-20·8; upper teeth (c-m<sup>2</sup>) 10·4-12. Forearm 62·8-73. (Guiana, Para, Lower Orinoco.) ..... *A. p. fallax*, p. 242.
- b*<sup>4</sup>. Tibia and interfemoral densely haired above; colour of fur of upper side in adults drab with a silvery tinge. Upper teeth (c-m<sup>2</sup>) 9·5-10·4 mm.; forearm 53·7-59·7 mm. (Mexico.) ..... *A. hirsutus*, p. 245.
- b*<sup>3</sup>. Molars  $\frac{2}{3}$ .
- c*<sup>3</sup>. Large: forearm 54-76 mm. .... *A. jamaicensis*, p. 247.
- c*<sup>4</sup>. Smaller races: length of skull (to front of c) 26-30 mm.; forearm 54-66 mm. Angular notch in hinder border of m<sup>2</sup>, between cusps 5 and 7 (place of lost m<sup>3</sup>), as a rule distinct, rarely quite obliterated; darker colour phase predominant; facial stripes as a rule wanting or faint, rarely strongly developed. (Northern races: Greater Antilles, as far east as St. Kitts; S. Mexico, C. America; extending to Colombia and Ecuador.)
- c*<sup>5</sup>. Average: length of skull (to front of c) 26·9 mm.; upper teeth (c-m<sup>2</sup>) 9·7; forearm 58·8. (Cuba.) ..... *A. j. parvipes*, p. 261.
- d*<sup>5</sup>. Average: length of skull 27·4 mm.; upper teeth 9·9; forearm 59·6. (Yucatan, Belize.) ..... *A. j. yucatanicus*, p. 263.
- c*<sup>6</sup>. Average: length of skull 28·3 mm.; upper teeth 10·3; forearm 60·1. (Greater Antilles, except Cuba, as far east as St. Kitts; Caribbean Islands; S. Mexico, except Yucatan; C. America.) ..... *A. j. jamaicensis*, p. 265.
- f*<sup>5</sup>. Average: length of skull 29·7 mm.; upper teeth 11; forearm 62·9. (Ecuador, Colombia.) ..... *A. j. equatorialis*, p. 270.
- d*<sup>4</sup>. Larger races: length of skull (to front of c) 29·5-34 mm.; forearm 60-76 mm. Angular notch in hinder border of m<sup>2</sup>, between cusps 5 and 7 (place of lost m<sup>3</sup>), as a rule reduced or obliterated, rarely perfectly preserved; lighter colour phase predominant; facial stripes distinctly or strongly developed, rarely wanting. (Southern races: S. America, extending to S. Mexico; from Trinidad to Guadeloupe; unrepresented in the Greater Antilles.)
- g*<sup>5</sup>. Averaging larger: forearm 64-76 mm. (S. America, extending to S. Mexico; { *A. j. lituratus*, p. 272.  
 Trinidad and St. Vincent.) ..... { *A. j. palmarum*,\* p. 278.
- h*<sup>5</sup>. Averaging smaller: forearm 60-66·2 mm. (Dominica, Guadeloupe.) ..... *A. j. præceps*, p. 283.
- d*<sup>3</sup>. Small: forearm 37·2-43·8 mm.
- e*<sup>4</sup>. Forearm 43·8 mm.; third metacarpal 39·4 mm. (Peru.) ..... *A. glaucus*, p. 285.
- f*<sup>4</sup>. Forearm 37·2-40·5 mm.; third metacarpal 33·7-36·2 mm. (C. America.) ..... *A. watsoni*, p. 288.

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\* Practically indistinguishable from *A. j. lituratus*.

- c*<sup>2</sup>. Molars  $\frac{2}{3}$ . All species small: forearm 36.5-46.8 mm.
- e*<sup>3</sup>. Cusp 7 of *m*<sup>1</sup> less developed.
- g*<sup>4</sup>. *m*<sup>2</sup> not reduced in size; equal to  $\frac{2}{3}-\frac{3}{4}$  of *m*<sup>1</sup> ..... *A. cinereus*, p. 290.
- i*<sup>5</sup>. Averaging smaller: maxillary width of skull (across *m*<sup>1</sup>) 8-8.6 mm.; forearm 39-42 mm. (Para, through Guiana to N.W. Venezuela, incl. Trinidad) ..... *A. c. cinereus*, p. 292.
- j*<sup>5</sup>. Averaging larger: maxillary width of skull 8.5-8.9 mm.; forearm 41.2-44 mm. (Colombia, to N.W. Venezuela.) ..... *A. c. bogotensis*, p. 293.
- h*<sup>4</sup>. *m*<sup>2</sup> considerably reduced in size; equal to only about  $\frac{1}{2}$  of *m*<sup>1</sup>. Forearm 37.8-39.8 mm. (Ecuador, Venezuela.) ..... *A. rosenbergi*, p. 293.
- f*<sup>3</sup>. Cusp 7 of *m*<sup>1</sup> more developed.
- i*<sup>4</sup>. Rostrum not unusually depressed and not bent upward; bony palate not shortened; distance from palation to hinder border of incisive foramina greater than (or equal to) distance from palation to basion.
- k*<sup>5</sup>. Rather smaller: length of skull (to front of c) 19.2-21.2 mm.; upper teeth (*c-m*<sup>2</sup>) 6-7.2; forearm 37.5-44; third metacarpal 33-40.5.
- d*<sup>6</sup>. Upper teeth (*c-m*<sup>2</sup>) 6.5-7.2 mm.
- a*<sup>7</sup>. Upper side of interfemoral densely haired ..... *A. toltecus*, p. 296.
- a*<sup>8</sup>. Averaging larger: forearm 39-43.5 mm. Darker colour phase predominant; facial stripes and white ear-edgings as a rule wanting or indistinct, rarely strong. (S. America, S. and C. Mexico.) ..... *A. t. toltecus*, p. 297.
- b*<sup>8</sup>. Averaging smaller: forearm 37.5-39.7 mm. Light colour phase predominant; facial stripes and white ear-edgings as a rule distinct or strong, rarely wanting. (Ecuador.) ..... *A. t. rarus*, p. 300.
- b*<sup>7</sup>. Upper side of interfemoral sparsely haired. Forearm 41.7-44 mm. (Guiana, Pernambuco.) ..... *A. quadrivittatus*, p. 302.
- e*<sup>6</sup>. Upper teeth (*c-m*<sup>2</sup>) 6 mm. No white ear-edgings. Forearm about 38 mm. (Yucatan, Vera Cruz.) ..... *A. phæotis*, p. 303.
- i*<sup>5</sup>. Rather larger: length of skull (to front of c) 22-22.8 mm.; upper teeth (*c-m*<sup>2</sup>) 7.5-7.6; forearm 45-46.8; third metacarpal 42-45. Interfemoral very short, densely haired. Facial stripes indistinct or wanting; no white ear-edgings. (S. Mexico.) ..... *A. aztecus*, p. 306.
- j*<sup>4</sup>. Rostrum unusually depressed and slightly bent upward; bony palate shortened: distance from palation to hinder border of incisive foramina less than distance from palation to basion.
- m*<sup>5</sup>. Larger: length of skull (to front of c) 20 mm.; upper teeth (*c-m*<sup>2</sup>) 6.7; forearm 40.5; third metacarpal 37. (S. Mexico.) ..... *A. turpis*, p. 307.
- n*<sup>5</sup>. Smaller: length of skull 18.2-18.7 mm.; upper teeth 5.8-6.1; forearm 36.5-38; third metacarpal 32.2-35. (S. and C. Mexico.) ..... *A. nanus*, p. 308.

*General Remarks.*

(a) *Artificial and natural arrangement of the species.*—The arrangement of the species of *Artibeus* given in the foregoing pages is based primarily on their number of molars:  $\frac{3}{3}$ ,  $\frac{2}{3}$ , or  $\frac{2}{2}$ ; it has the practical advantage of facilitating the identification of the species; it is easier to count the teeth than to study their detailed structure. But I have no doubt that it is thoroughly artificial. Briefly epitomised the arrangement is this:—

A.  $\frac{3}{3}$  molars.

a. Cusp 7 of  $m^1$  small: no living species.

b. Cusp 7 of  $m^1$  large: *concolor*, *planirostris*, *hirsutus*.

B.  $\frac{2}{3}$  molars.

a. Cusp 7 of  $m^1$  small: *glaucus*, *watsoni*.

b. Cusp 7 of  $m^1$  large: *jamaicensis*.

C.  $\frac{2}{2}$  molars.

a. Cusp 7 of  $m^1$  small: *cinereus*, *rosenbergi*.

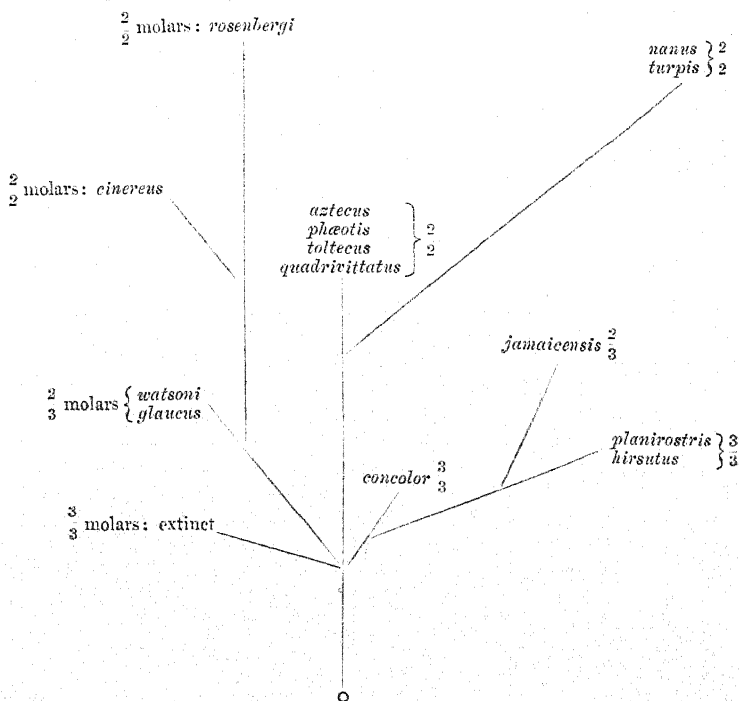
b. Cusp 7 of  $m^1$  large: *quadrivittatus*, *toltecus*, *phaeotis*, *aztecus*;—*turpis nanus*.

This and any other arrangement of the species based primarily on the number of molars is, I believe, open to the following objections:—Is it likely that the presence or absence of a rudimentary tooth ( $m^3$  and  $m_3$ ) is more important, in taxonomic respect, than the general level of development at which the structure of the upper molars (small or large cusp 7 in  $m^1$ ) has arrived? It has been pointed out in the foregoing pages that a certain small percentage of individuals of the species with normally  $\frac{3}{3}$  molars have  $\frac{2}{3}$  only (see *A. planirostris* and *hirsutus*); that in the species with normally  $\frac{2}{3}$  molars individuals occur which have  $\frac{2}{2}$  only (see *A. jamaicensis*); and that a few individuals of species with normally  $\frac{2}{2}$  molars have  $\frac{3}{3}$  (see *A. rosenbergi* and *toltecus*): bearing this in remembrance, is it then likely that a character which is vacillating among individuals of the same species and geographical race is of primary, and a character which is constant within the species (the structure of the upper molars) of secondary importance? If the number of molars were of fundamental importance in this genus, is it then likely that we should find in the lowest section ( $\frac{3}{3}$  molars) species which have the most advanced structure of the upper molars (*planirostris*, *hirsutus*), and among the species of the highest section ( $\frac{2}{2}$  molars) such as have retained a low character (small cusp 7) in the upper molars? Is it likely that *A. jamaicensis*, because it has lost the rudimentary  $m^3$  (although some of the races have as a rule retained the notch in  $m^2$  indicative of the former place of  $m^3$ ), is more closely related to *A. glaucus* and *watsoni*, from which it differs in the structure of the upper molars, than to *A. planirostris*, with which it accords in this as in every other respect except the loss of a rudimentary tooth? These and similar considerations seem, with necessity, to lead to the conclusion that the old and till now universally accepted arrangement of the species according to their number of

molars does not give an adequate idea of their true mutual relationships. If, however, we take as the leading character, not the presence or absence of the vanishing  $m^2$  and  $m_3$ , but the smaller or greater development of cusp 7 of  $m^1$ , all the objections indicated above, as far as I can see, are removed, and we then arrive at the following scheme:—

- A. Cusp 7 of  $m^1$  relatively small.
  - a. Molars  $\frac{2}{2}$ : no living species.
  - b. Molars  $\frac{2}{2}$ : *glaucus*, *watsoni*.
  - c. Molars  $\frac{2}{2}$ .
    - a.  $m^2$  of normal size: *cinereus*.
    - β.  $m^2$  reduced: *rosenbergi*.
- B. Cusp 7 of  $m^1$  large.
  - a. Molars  $\frac{3}{3}$ .
    - a. Rostrum short: *concolor*.
    - β. Rostrum normal: *planirostris*, *hirsutus*.
  - b. Molars  $\frac{3}{3}$  (species closely allied to *planirostris*): *jamaicensis*.
  - c. Molars  $\frac{2}{2}$  (none of the species closely allied to those of sections B a and B b).
    - a. Rostrum and palate normal: *quadrivittatus*, *toltecus*, *phæotis*, *aztecus*.
    - β. Rostrum unusually flattened, palate shortened: *turpis*, *nanus*.

Or expressed in the form of a diagram:—





According to this arrangement there are two principal branches of the genus: in the one, and more primitive, cusp 7 of  $m^1$  is proportionally small, in the other it is largely developed. The former, as being the more primitive, is quite naturally but poorly represented among recent species; the latter is flourishing. Of the lowest section (molars  $\frac{3}{3}$ ) of the primitive branch (small cusp 7) no living species are known, but there are species with  $\frac{3}{3}$  molars (*glaucus, watsoni*), and  $\frac{2}{2}$  molars (*cinereus, rosenbergi*); the latter species, *rosenbergi*, has attained an unusually high development (not only loss of  $m^3$  and  $m_3$ , but also reduction of  $m^2$  and  $m_2$ ). Of the higher branch (large cusp 7) all sections are represented by recent species:  $\frac{3}{3}$  molars in *concolor* (peculiarly short-faced), *planirostris* and *hirsutus*, the two latter species very closely allied;  $\frac{2}{2}$  in *jamaicensis*, otherwise differing in next to nothing from *planirostris*;  $\frac{2}{2}$  in quite a number of species (*quadrivittatus, toltecus, phaeotis, aztecus, turpis, nanus*), among which *turpis* and *nanus* mark the highest stage of development, in so far as the rostrum has become unusually depressed and the palate shortened.

(b) *Artibeus planirostris* and its races.—*A. planirostris planirostris* has spread over the whole continental area from Central Brazil to S. Mexico; the complete resemblance, even in average size, between specimens from Mexico and S. America, and the absence of the race from any of the West Indian Islands, are evidence that it has reached Central America (N. of the Nicaragua depression) and Mexico in a very recent epoch, at all events at a time when the Greater Antilles were separated from the mainland by water of sufficient breadth to constitute an absolute barrier for the spreading of the race from the latter into the former. *A. p. trinitatis* is apparently confined to the Venezuelan coast islands, Trinidad and Tobago, *A. p. grenadensis* to Grenada. These three races are so extremely closely inter-related, being distinguishable only by small average differences in size, that from a broader point of view they may be regarded as one form. In relatively strong contrast to this form stands the large-skulled, large-toothed, and as a rule also externally larger-sized *A. p. fallax*, the true home of which seems to be Guiana, a part of S. America which in a late geological epoch constituted an isolated insular area; all the Guianan specimens of *A. planirostris* I have seen (51 in number, collected at different places, by different collectors, and at different times) are *A. p. fallax*; if, therefore, Guiana is the place of origin of this race, it has spread from there to the Lower Orinoco (Ciudad Bolívar) and Lower Amazons (Para); along the numerous southern affluents of the Amazons it has probably made its way to Peru ("*A. hercules*," apparently indistinguishable from *A. p. fallax*).

(c) *The races of Artibeus jamaicensis, their geographical distribution, and its bearing on a past connection of the West Indies and the Central American mainland* (see map, p. 319).—(1) The seven races of *Artibeus jamaicensis* recognised in this paper fall into two natural groups:—*A. j. parvipes*, *yucatanicus*, *jamaicensis*, and *aequatorialis* on the one side; *A. j. lituratus*, *palmarum*, and *praeceps* on the other side. The former group, which may be called the “northern,” is distributed over Central America, South and Central Mexico, and the Greater Antilles, and has sent a branch southward, through the Cordilleras, as far as Ecuador. The latter group, the “southern,” ranges from Paraguay and S. Brazil northward through South and Central America to Central Mexico, and has sent a branch to the Windward Islands, as far north as Guadeloupe.

(2) In the northern group of races the individuals are generally considerably smaller; the angular notch in the posterior margin of  $m^2$ , between its cusps 5 and 7, is generally as well marked as in *A. planirostris*, sometimes reduced, rarely completely filled up; the coloration of the fur is chiefly of the dark type, the facial stripes as a rule obsolete or less distinct. In the southern group the individuals are generally considerably larger; the angular notch in the posterior margin of  $m^2$  is rarely well preserved, generally more or less reduced, often completely filled up; the coloration chiefly of the lighter type, with the facial stripes, particularly the supraorbital stripes, as a rule well marked or even very strong.

(3) The close resemblance between *A. j. parvipes*, from Cuba, and *A. j. yucatanicus*, from Yucatan,—closer than between *A. j. parvipes* and its nearest eastern and southern neighbour (in San Domingo and Jamaica), *A. j. jamaicensis*—is evidence of a past closer land connection (or approximation) between Cuba and Yucatan, than between Cuba and San Domingo, or Cuba and Jamaica.

(4) *A. j. jamaicensis* ranges from Central Mexico to Panama, from Honduras to Jamaica, San Domingo, Porto Rico, as far east as St. Kitts. The perfect resemblance between individuals from all these places is evidence of a past complete, or nearly complete, connection between Jamaica and the coast of Honduras and Nicaragua. I do not see any other reasonable explanation of the fact that precisely the same race occurs in Central America, Jamaica, San Domingo, and Porto Rico, whereas Cuba is inhabited by a clearly different race, the relationships of which are with the Yucatan, not with the Jamaican, race. The past connection between Jamaica and the mainland may have been complete; but this assumption is not necessary to explain the present distribution of *A. j. jamaicensis*; the Mosquito Coast and Jamaica are, as well known, connected by extensive submarine banks, the Mosquito and S. Pedro banks (part of the latter above the surface of the water); an elevation of about 100 fathoms

would leave between the Mosquito Coast and Jamaica only two channels, the wider 75 miles; these channels would be so narrow as to form no serious barrier for the spreading of a bat.

(5) The geological line of separation between the Larger and Lesser Antilles runs, probably\*, between the Virgin Islands and Anguilla; the Virgin Islands therefore belong geologically to the Larger, Anguilla to the Lesser Antilles. Though Antillean and Central American in origin, *A. j. jamaicensis* has in the course of time crossed this line; coming from west (Porto Rico) it has spread a little east of the line, at least as far as St. Kitts. But there, or in some neighbouring island, the range of the race seems to terminate; farther southward in the chain of the Lesser Antilles (Guadeloupe, Dominica) is found a race (*A. j. princeps*) which has no direct phylogenetic connection with *A. j. jamaicensis*, but is an offshoot of the S. American *A. j. palmarum*.

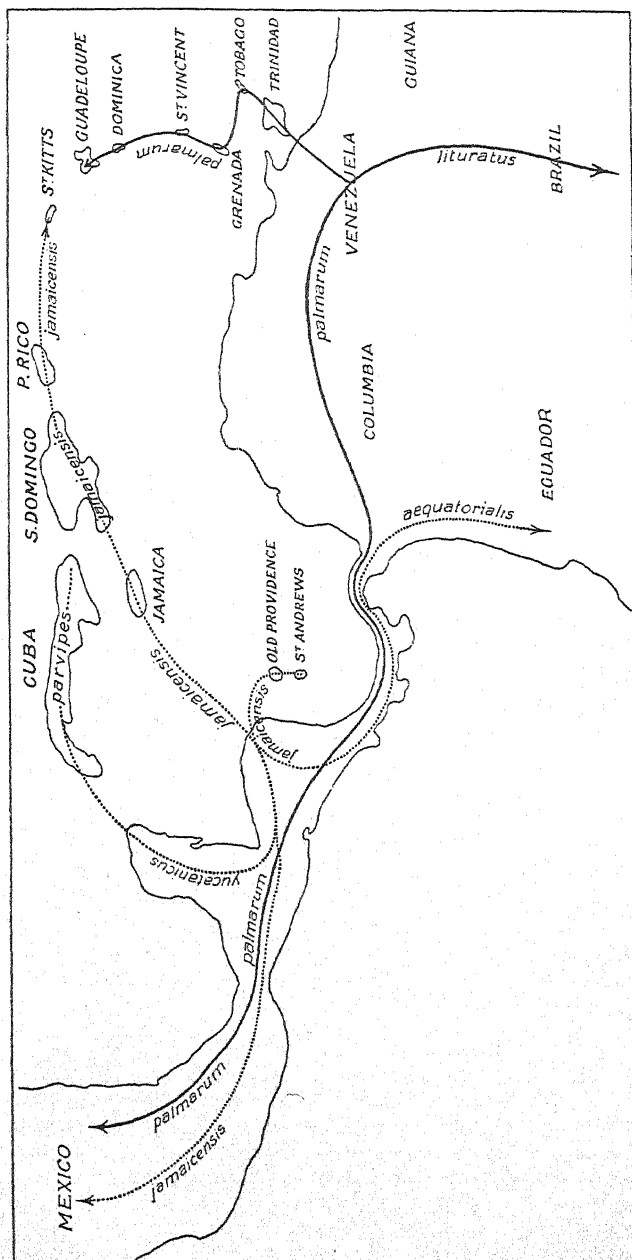
(6) The direct connection between the northern and southern American continent has given *A. j. jamaicensis* the opportunity of spreading southward, through the Cordilleras, as far as Ecuador, where it has developed into the comparatively large-sized, large-skulled, and large-toothed *A. j. equatorialis*.

(7) While it is safe to assume that *A. j. parvipes*, *yucatanicus*, and *jamaicensis* are of "northern," i. e. Central American-Antillean, origin, and *A. j. equatorialis* an Andean offshoot of this northern branch, it is equally beyond doubt that *A. j. lituratus* and *palmarum* are of S. American origin, for the following reasons:—first, *A. j. palmarum*, from Venezuela, is so extremely closely related to *A. j. lituratus*, from Brazil and Paraguay, as to be, for all practical purpose, indistinguishable; given that *A. j. lituratus* is of S. American origin, *A. j. palmarum* is therefore the same; second, the range of *A. j. palmarum* extends from Venezuela, through C. America to S. Mexico, but the race is completely absent from the Larger Antilles, an evidence that it has reached C. America and Mexico at a time when the Larger Antilles were definitely separated from the mainland; third, whereas *A. j. jamaicensis* is common (and equally common) everywhere in C. America and S. Mexico, *A. j. palmarum* becomes rarer and rarer farther north in C. America, until in S. Mexico it is very rare, an additional evidence that *A. j. jamaicensis* is the indigenous race, *A. j. palmarum* an immigrant from the south.

(8) The southern group has spread from the mainland over the Windward Islands. Individuals from the Venezuelan coast islands, Trinidad and St. Vincent, are indistinguishable from the continental *A. j. palmarum*. But farther north, in Dominica and Guadeloupe, they have developed into a slightly different race, *A. j. princeps*.

\* A. Agassiz, Three Cruises of the 'Blake,' i. p. 112 (1888).

Text-fig 59.



Sketch of distribution of the races of *Artibeus jamaicensis* in Mexico, C. America, the West Indies, and Northern S. America.

Dotted line: northern races (*parvipes*, *yucatanicus*, *jamaicensis*, *aequatorialis*). | Black line: southern races (*lituratus*, *palmarum*, *praeceps*).

The name *praeceps*, opposite Dominica and Guadeloupe, has been inadvertently omitted by the artist.

2. On certain Points in the Structure of the Cervical Vertebrae of the Okapi and the Giraffe. By Sir RAY LANKESTER, K.C.B., F.R.S., F.Z.S.

[Received March 14, 1908.]

(Text-figures 60-71.)

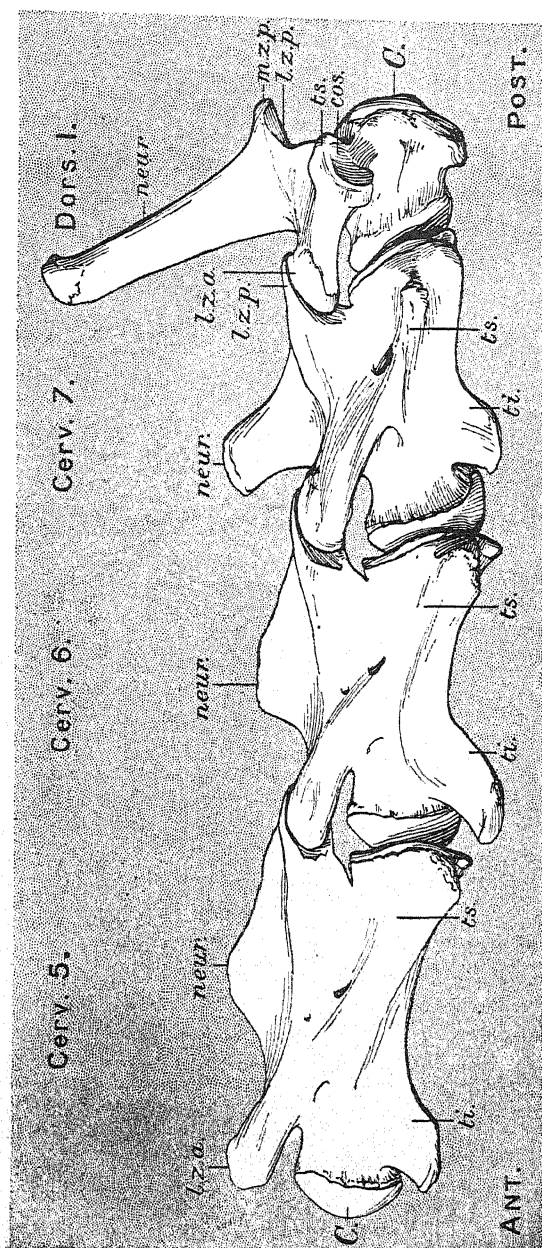
Among the material relating to the Okapi which has been acquired by the British Museum (Natural History), is a fine skeleton of a nearly but not quite adult male, obtained from Major Powell Cotton. It is the skeleton of the individual the skin of which was presented by that gentleman and is exhibited in the public gallery.

I have made some study of this skeleton, comparing the bones with those of the Giraffe. Since I commenced this study, Professor Fraipont of Liège has published his finely illustrated account of the specimens of Okapi preserved in the Museum of the Congo State at Tervueren near Brussels.

The most important difference between the general bony skeleton of Okapi and that of Giraffe—as distinct from the cranium—is one which is presented by the last three cervical and first dorsal vertebrae of the two animals. A certain difference in the form and proportions of the cervical vertebrae—as between Okapi and Giraffe—is what one expects as the necessary correlative of the much greater length of the neck in Giraffe. But the difference goes a good deal beyond this—as a glance at the drawings given in text-figs. 60 and 61, of the vertebrae, cervical 5, 6, 7, and dorsal 1, at once shows.

The neural spines (*neur.* in the figures) of the cervical vertebrae of the Giraffe are much shorter proportionately than are those of the Okapi—and this is especially the case in cervical 7. Further, the inferior transverse processes (*ti.* in the figures)—lateral outgrowths which in the mammalian vertebral series are peculiar to the cervical region—are very different in the Giraffe from those of the Okapi. In the Giraffe they are of small proportional size, entirely anterior in position on each vertebra (see text-fig. 60). In the Giraffe a right and a left inferior transverse process exist on the seventh cervical vertebra—as well as on the vertebrae in front of it.

Not so in the Okapi (see text-fig. 61). Whilst cervical 5 (as well as 4 and 3) has a large inferior transverse process (I speak of the side view as given in the drawing and therefore of one only of the pair of lateral processes) which grows downwards (abaxially) from the anterior part of the vertebra—and is larger than the corresponding process in Giraffe—cervical 6 has its inferior transverse process in the form of an enormous flange or plate extending the whole length of the vertebra. This does not exist in Giraffe: in that animal the inferior transverse process (*ti.* text-fig. 60) of

Text-fig. 60.  
GIRAFFE.

The last three cervical vertebrae and the first dorsal vertebra of the Giraffe, seen from the left side.

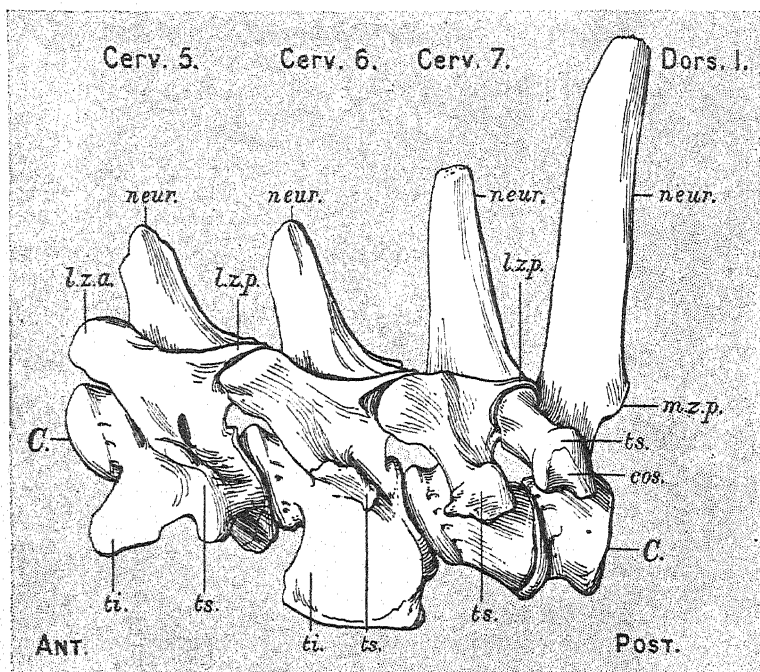
*C.*, centrum; *neur.*, neural spine; *ts.*, superior transverse process; *ti.*, inferior transverse process; *cos.*, articular facet for the tubercular process of the first rib; *l.za.*, anterior lateral zygapophysial facet; *l.z.p.*, posterior lateral zygapophysial facet; *m.z.p.*, median zygapophysial (so-called) facet.

Note the small size of *ti.* on the sixth cervical and the contrast between the size of *neur.* of Dors. 1 and Cerv. 7.

cerv. 6 is but little bigger in depth and extension than is that of cerv. 5 or cerv. 7.

Text-fig. 61.

### OKAPI



The last three cervical vertebrae and the first dorsal vertebra of the Okapi (*Okapia johnstoni*), seen from the left side.

Lettering as in text-fig. 60.

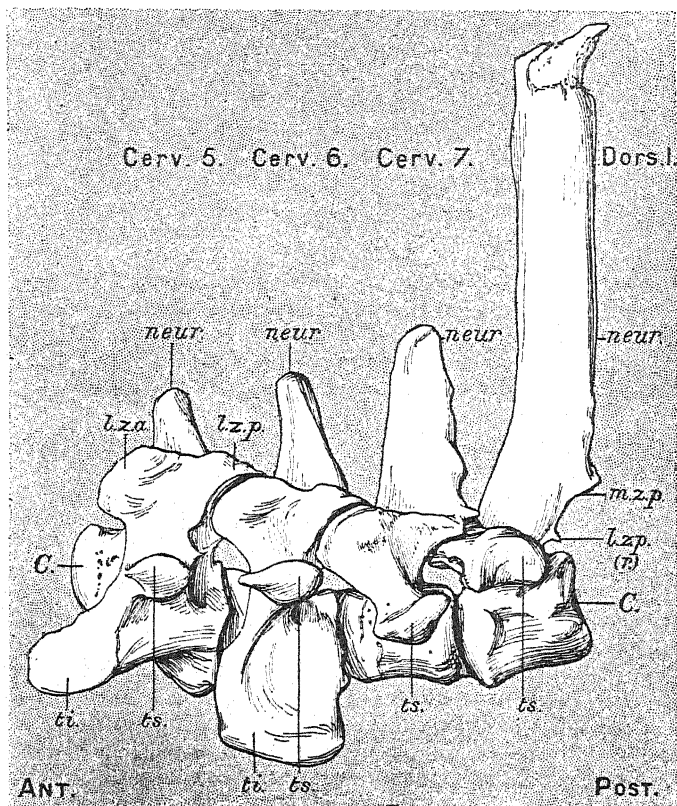
Note the great size and backward extension of *ti.* of Cerv. 6, the complete absence of *ti.* from Cerv. 7, and the approximation in general proportion of Cerv. 7 to Dors. 1.

The next difference is that in the seventh cervical of Okapi there is no inferior transverse process at all; whilst the superior transverse process *ts.* is greatly enlarged, expanded and flattened at its free end. No such appearance is presented by the seventh cervical of the Giraffe, which contrasts very strongly with that of the Okapi. In fact, the seventh cervical of the Giraffe has the general appearance and character of the cervical series, whilst the seventh cervical of the Okapi is, in all its characters except that of actually giving articulation to a bony rib, a dorsal. We may describe this by saying that the last cervical is "dorsalized."

The contrast in this respect between Giraffe and Okapi is very great, as text-figs. 60 and 61 clearly show.

Text-fig. 62.

BOS TAURUS.



The last three cervical vertebrae and the first dorsal of a domestic Ox (*Bos taurus*), seen from the left side.

Letters as in text-fig. 60, except *l.z.p.(r.)*, which points to the rudimentary posterior lateral zygapophysial process of the first dorsal vertebra.

Note the close agreement of these five vertebrae with those of Okapi and their difference from the same group in Giraffe.

It may perhaps be possible to show that these differences of proportion in the neural spines and transverse processes are connected with the special mechanism of the very long neck of Giraffe. The greater size and breadth of these bony processes is merely an expression of the greater size of the muscle-tendons and of the ligaments, of which they may be regarded as but denser



ossified parts. The fact, however, as we have seen, is that the long-necked Giraffe presents a smaller development of these processes of the vertebræ of the cervico-dorsal region than does the shorter-necked Okapi; the Giraffe's cervicals (from cerv. 3 backwards) are practically all alike, and even the first dorsal is not so marked in the contrast it presents to the cervicals as is the first dorsal of Okapi to the cervicals in front of cerv. 7, which is, itself, strongly dorsal in character in the contrast it presents.

The sloping forwards of the neural spine of the first dorsal of Giraffe and the inclination of the plate formed by the superior transverse process and anterior zygapophysis in that vertebra is similar to that of the vertebræ in front of it (see text-fig. 60, *ts.* & *l.z.a.*).

The condition of the vertebræ cerv. 5, 6, 7, and dors. 1, in Okapi, thus seen in lateral view, is however not in any way peculiar to Okapi. It is the condition common to the Artiodactyle Ruminants, as is shown by the drawing of the same four vertebræ of the common Bovine (*Bos* sp.) given in text-fig. 62. In all the features above noted, in which the vertebræ of Okapi differ from those of Giraffe, Okapi agrees with the Bovine. The large flange-like development of the inferior transverse process of the sixth cervical, giving it a wide posterior extension, is present in all Cavicorn and Cervine genera. It is, moreover, as well marked in the long-necked Camel as in the short-necked Bovines, and is present in the non-ruminant forms, the Pigs and the Hippopotamus. In the Camel (text-fig. 63) the inferior transverse process of the fifth, fourth, and third cervicals is large, plate-like and triangular, wanting the large posterior growth characteristic of the sixth cervical.

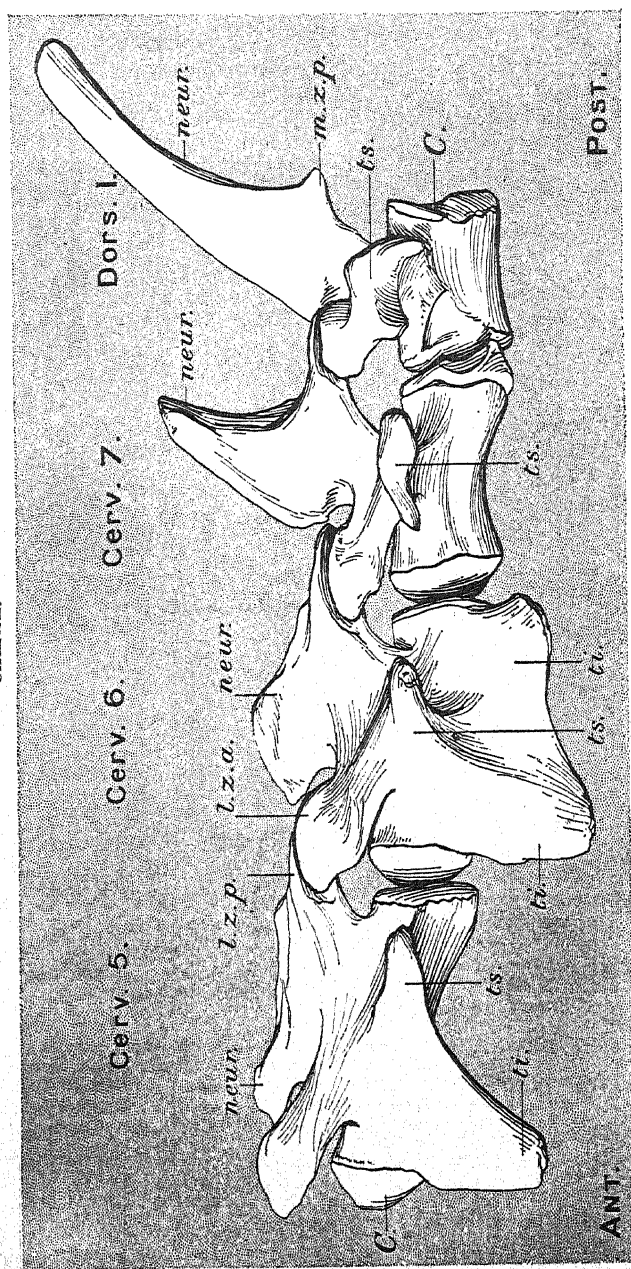
But in the Pigs—presumably a more primitive stage of Artiodactyle development than that presented by any of the Ruminants—the inferior transverse process has a broad square outline (with posterior region well developed), in the fifth and fourth cervicals as well as in the sixth, though the process is biggest in the sixth and totally absent in the dorsal-like seventh. In the third cervical the inferior transverse process is much less in lateral outgrowth, but still has a strongly developed posterior region projecting backwards below and behind the superior transverse process.

The inferior transverse process of the cervical vertebræ is well developed in the Carnivora as in the Pig, the special enlargement and plate-like character of that of the sixth cervical being as in the Ungulata.

In the Insectivora—as shown more especially by *Centetes*—the superior transverse process of cervicals 7, 6, 5, 4, 3, 2, and even 1, is well developed, and it is only on cerv. 6 that the inferior transverse process is developed to any size; cervicals 5 and 4 have a small development of it. In the Hedgehog the inferior transverse process of cervical 6 is enormous and grows downward and backward on each side of the neck as a very obvious and striking pair of plates.

Text-fig. 63.

## CAMEL.



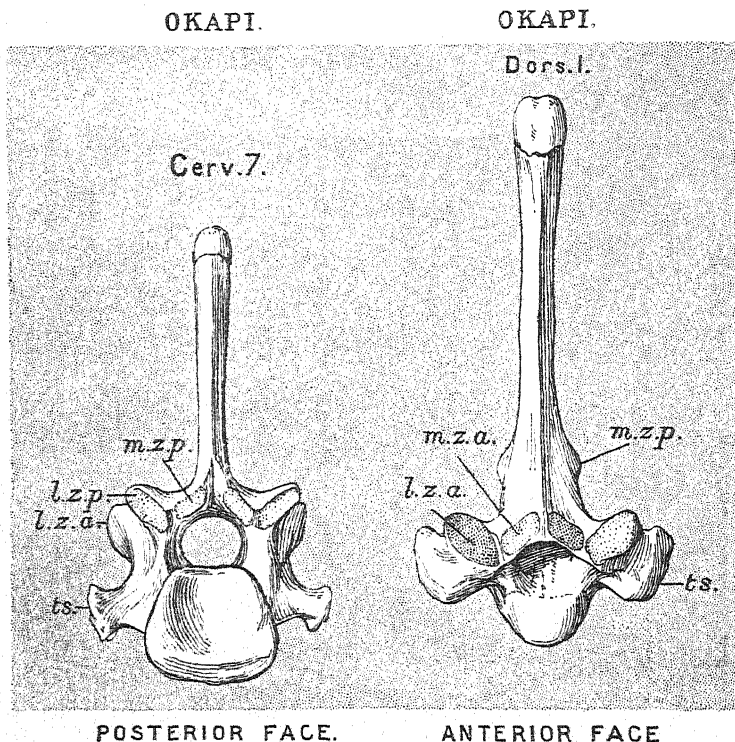
The last three cervical vertebrae and the first dorsal vertebra of the Camel seen from the left side.

Letters as in text-fig. 60.

[Note the general agreement with *Dos* and *Okapi*, together with the larger and more plate-like development of *ti*, on Cerv. 5.]

The inferior transverse process is to be regarded as a bifurcation of (or an accessory inferior plate of) the one transverse process which is usually recognised (in the cervical region) as the superior transverse process. On the present occasion it is not convenient to discuss further its morphology.

Text-fig. 64.



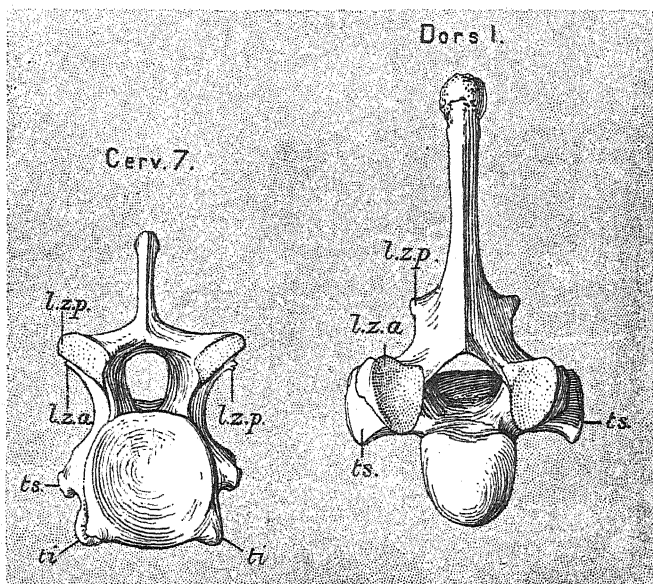
The posterior face of the seventh cervical vertebra and the anterior face of the first dorsal vertebra of the Okapi (*Okapia johnstoni*), to show the duplicated character of the articular facets.

*m.z.p.*, posterior median articular facet of Cerv. 7; *m.z.a.*, anterior median articular facet of Dors. 1, which articulates with the foregoing; *l.z.p.*, posterior lateral articular facet of Cerv. 7, raised on a distinct zygapophysis; *l.z.a.*, anterior lateral articular facet also raised on a zygapophysis, seen fully in Dors. 1 (and partially in Cerv. 7); *l.z.a.* of Dors. 1 articulates with *l.z.p.* of Cerv. 7; *ts.*, superior transverse process.

There are a number of interesting details to be observed and discussed in regard to these minor processes of the vertebræ in different groups of mammals. My purpose is not now to enter on that subject, but merely to show briefly what is the value of the

difference between Okapi and Giraffe in regard to the inferior transverse process of the cervical region—when the chief facts as to this structure in other mammals are taken into view. Clearly enough it is Giraffe which is altogether exceptional, novel and specialised, not archaic or atavistic. Giraffe has not even the great plate-like inferior transverse process on its 6th cervicals, which is obvious and prominent in such widely separate forms as the

Text-fig. 65.

**GIRAFFE.****GIRAFFE.****POSTERIOR FACE.****ANTERIOR FACE.**

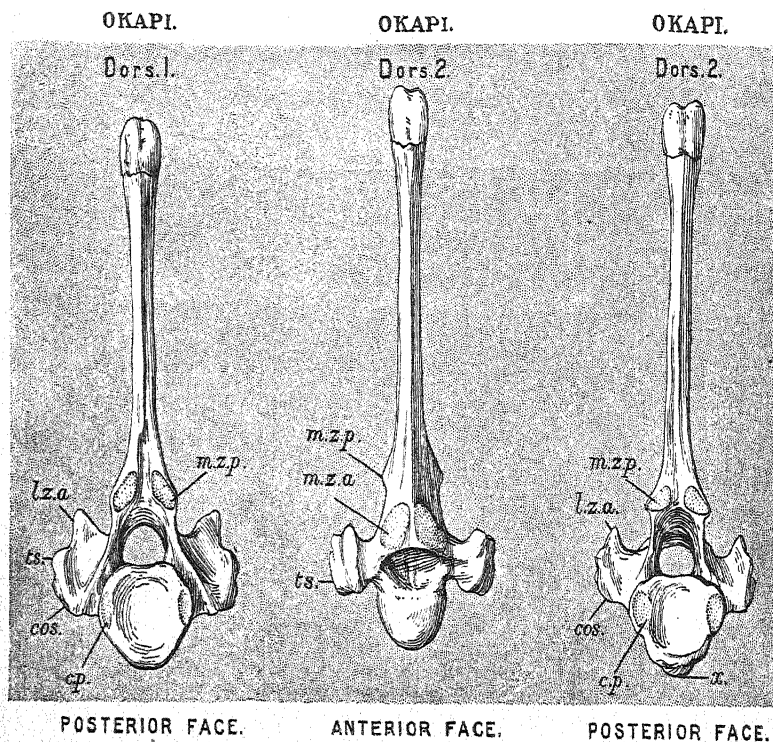
The same view of the same vertebrae in Giraffe as that given in the case of Okapi in text-fig. 64. The figure shows the single pair of articular facets raised on zygapophyses. No median facets on the sides of the neural arch are developed.

Letters as in text-fig. 64, except *ti.*, inferior transverse process of Cerv. 7.

Hedgehog, the Carnivora, and the commoner Ungulata. Okapi merely agrees with other Ruminant Ungulates in the matter of its adjacent cervical and dorsal vertebrae, and they seem to be a little more specialised, than the Pigs and Perissodactyles, in having a large inferior transverse process only on the 6th cervical and quite small ones on the vertebrae in front; whereas Pigs and Perissodactyles have that process more equally developed on all the cervical series 3, 4, 5, 6. The emphasis of the inferior transverse process on cerv. 6 appears to be the rule in *Mammalia* and

is carried very far in *Erinaceus*. Whether the existence of an inferior portion or inferior transverse process should be regarded as a primitive feature of all these vertebræ in Mammalia is not clear. It certainly seems to belong as an original element of structure to cervicals 3, 4, 5 and 6—to be increased greatly in size on cerv. 6 in most groups, and sometimes to practically disappear from the other cervicals whilst remaining there.

Text-fig. 66.



View of the articular surfaces which connect dorsal 1 and dorsal 2 of the Okapi, and of the anterior half of the articulation between dorsal 2 and dorsal 3. The articular facets are seen to be single pairs and to consist of an oval surface (*m.z.p.*, *m.z.a.*) placed entirely on the neural arch. The left anterior articular facet of dorsal 2 (middle figure) shows a tendency to divide into two.

Letters as in text-fig. 64, with the addition of *cos.*, process for the articulation of the tubercle of the first rib; *c.p.*, concave facet for the head of the second rib; *x.*, hypapophyseal tubercle.

In Giraffe, as a marked exception, it is small in all the cervicals and smaller in cerv. 6 than in the cervicals in front of that one, indeed so much reduced that it has no posterior extension at all but is represented by a small triangular anterior growth only.

## DOUBLE ZYGAPOPHYSEAL ARTICULAR SURFACES IN OKAPI.

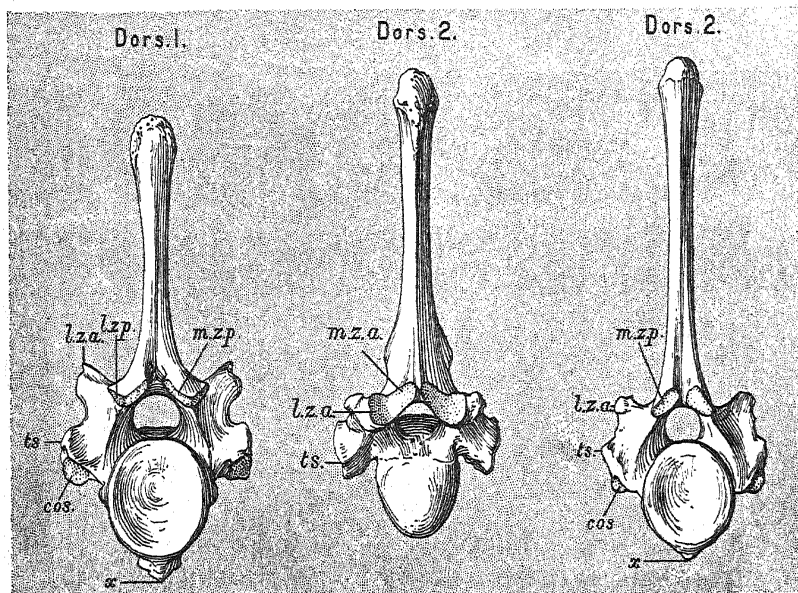
The posterior face of cerv. 7 and the anterior face of dors. 1 of the Powell Cotton skeleton of Okapi are drawn in text-fig. 64 in order to show a remarkable condition of the articular surfaces which bring these two vertebrae into relation. Whilst cerv. 6 of Okapi has only the usual single pair of anterior and posterior articular facets, common in cervical vertebrae, and situated on the zygapophyses themselves, the seventh cervical of this specimen of Okapi shows on the posterior face an additional mediad pair of

Text-fig. 67.

GIRAFFE.

GIRAFFE

GIRAFFE.



POSTERIOR FACE.

ANTERIOR FACE.

POSTERIOR FACE.

A similar view to that given in text-fig. 66 of the corresponding vertebrae of the Giraffe. The posterior face of dorsal 1 and the anterior face of dorsal 2 show duplicated facets (*l.z.p.* and *m.z.p.*, *l.z.a.* and *m.z.a.*) unlike dorsal 1 and dorsal 2 of Okapi, but like cervical 7 and dorsal 1 (see text-fig. 64) in that animal. The lateral element, however, entirely disappears from the articular surfaces connecting dorsal 2 and dorsal 3, as shown by the view of the posterior face of dorsal 2.

Letters as in the preceding text-figures.

articular facets quite distinct from the lateral pair (text-fig. 64, *m.z.p.*, cerv. 7), whilst the anterior face of dors. 1 drawn in the same figure shows two articular surfaces on the anterior face (*l.z.a.*, *m.z.a.*).

If we pursue the enquiry as to the articular surfaces, we find on examining the posterior face of dors. 1 and both faces of dors. 2

as shown in text-fig. 66, that it is obvious that the mediad articular surfaces which co-exist in cerv. 7 (posterior face) and dors. 1 (anterior face) with the lateral articular surfaces, are new and independent morphological entities and are identical with the articular surfaces of the dorsal vertebræ, whilst the laterally placed articular surfaces of the cervicals raised upon distinct "zygapophyses" have no existence in the dorsal series except on the anterior face of the first dorsal.

It seems to me that we are entitled to conclude from the specimen here figured (text-figs. 64 and 66) that the zygapophyses of the cervical vertebræ of the Mammalian series are not merely in a different position from that occupied by the articular facets of the dorsal vertebræ, but that the cervical and the dorsal articular surfaces are *distinct* morphological entities. The articular facet is not bodily "shifted" in position, when we pass from cervical to dorsal, but a distinct and independent mediad facet is substituted for the lateral facet. At the same time it must be recognised that the two articular facets can become confluent, and that one is to be regarded as an extension and "pullulation" of the other. So far as I am aware, this is a new observation.

I hasten to say that in the cerv. 7 and dors. 1 of another skeleton of Okapi (the property of Mr. Walter Rothschild) the two articular facets of each side drawn in text-fig. 64 are not marked off from each other, but confluent and ill-defined. The vertebræ of that skeleton differ in many remarkable points of size and proportions from those of the Powell Cotton skeleton. Though the Rothschild skeleton is that of a very young animal far from complete in growth, whilst the Powell Cotton skeleton is that of a full-grown animal with nearly adult dentition, yet many parts of the vertebræ of the younger animal are much larger than the same parts in the older animal. At the same time in other details the latter shows the greater size. It is possible that the Powell Cotton specimen is exceptional and abnormal, or that it belongs to a local race differing from that to which the Rothschild skeleton belongs. Or again, and this I think to be the most likely case, it seems from the variability of Okapi in regard to the striping of the skin and various proportions of the skull, also as to the symmetry of the horns of either side and as to the molar teeth, that there is great range of variation in the species—and that this variability extends even to such points as the exact form of the vertebræ and the development of articular facets connecting successive vertebræ. It is also possible that the absence of a distinct second pair of facets at the articulation between cerv. 7 and dors. 1 in this particular specimen of Okapi is due to its immature stage of growth.

A comparison of these vertebræ of Okapi with those of Giraffe—in regard to the zygapophyses and articular surfaces or facets—becomes now especially interesting.

In text-fig. 65 the same views of the two vertebræ (cerv. 7 and

dors. 1) of Giraffe are shown as are shown in the case of Okapi in text-fig. 64. It is at once seen that there is no question of the presence of a second pair of articular surfaces, of mediad position, in Giraffe, so far as this articulation is concerned.

Let us now go on to examine the posterior face of dors. 1, and both faces of dors. 2 in Giraffe. These are drawn in text-fig. 67 for comparison with similar views of the same vertebrae of Okapi drawn in text-fig. 66.

The remarkable fact is at once obvious that the articulation between dorsal 1 and dorsal 2 in Giraffe shows some of the characters of the articulation between cervical 7 and dorsal 1 of the Powell Cotton Okapi. There is on the posterior face of the Giraffe's dors. 1, a lateral and a median articular surface which are not separate from one another but confluent. And the same is true as to the corresponding articular surface on the anterior face of the Giraffe's dorsal 2.

The lateral articular facet belonging to the true zygapophysis of the cervical vertebrae is in Giraffe continued into the dorsal series—and does not disappear until we come to the articulation between dorsal 2 and dorsal 3 (see below as to Rhinoceros). In fact the first dorsal of the Giraffe is in this respect drawn (as it were) into the cervical series. The break in the vertebral series which occurs in Okapi (and normal Ungulata) between the anterior and posterior faces of dorsal 1 is in Giraffe pushed down the series and shows itself in the contrast between the anterior and posterior faces of dorsal 2. There is, what has been called in regard to such serial metameric elements of structure, "homœosis" of the first dorsal of the Giraffe—assimilating the articular facets of that vertebra to those of the seventh cervical.

The complete investigation of this question of the characters of the last cervicals and first dorsals—and the transition from the one group to the other and the greater or less abruptness of the break between them in the whole Mammalian series, would form an interesting enquiry.

At present I must content myself with formulating the facts, *firstly*, that in both Okapi and in Giraffe there is (as an exception in Ungulata) a co-existence of lateral and mediad articular facets of independent morphological value—at one of the vertebral articulations at the base of the neck: and *secondly*, that the articulation at which this occurs is in Okapi that between cervical 7 and dorsal 1—whereas in Giraffe it is shifted one place backwards in the series and occurs between dorsal 1 and dorsal 2.

The relation of these peculiarities to the elongation of the cervical region or to any other peculiarities of the animals in question, is a matter for further enquiry.

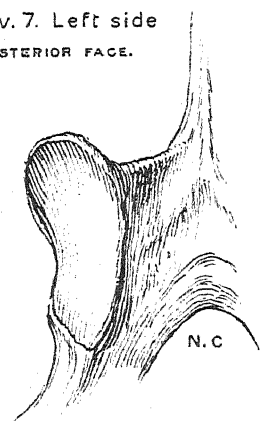
I am able to add to this the following additional observations which I have made in the Museum of the Royal College of



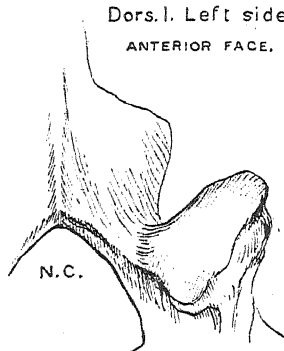
Surgeons\*. In the Ruminants generally the substitution of

Text-fig. 68.

Cerv. 7. Left side  
POSTERIOR FACE.



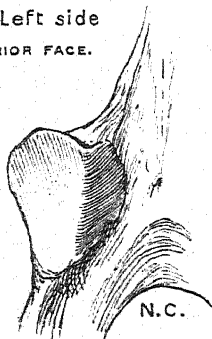
Dors. 1. Left side  
ANTERIOR FACE.



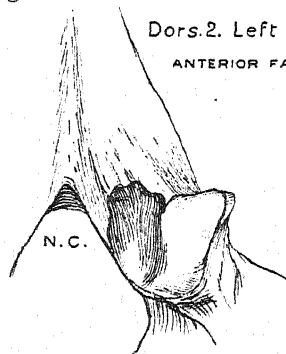
The articular facets of the left side on the posterior face of Cervical 7 and anterior face of Dorsal 1 of *Rhinoceros sumatranus*.  $\frac{2}{3}$  nat. size.  
N.C., neural canal. To show single lateral facet.

Text-fig. 69.

Dors. 1. Left side  
POSTERIOR FACE.



Dors. 2. Left side  
ANTERIOR FACE.



The articular facets of the left side on the posterior face of Dorsal 1 and anterior face of Dorsal 2 of *Rh. sumatranus*.  $\frac{2}{3}$  nat. size.  
To show elongated facet, including lateral and medial factors.

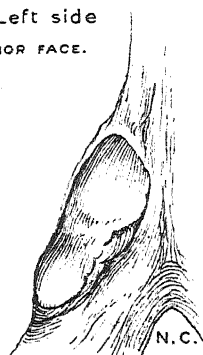
the mediad pair of facets for the more laterally placed pair

\* I desire to take this opportunity of pointing out that though the osteological series of the Hunterian Museum is a most valuable and useful one, it is yet not very large and does not contain second and third specimens for comparison. Such a collection as the zoologist really requires ought to be formed at the Natural History Museum. The osteological collection of that museum is at present very small and not such as is necessary for reference and comparison. A large room in the basement was arranged by me to receive such a collection, which I had intended to keep mounted on flat boards and movable: the boards to be fixed as sliding-shelves in dust-tight cabinets. An assistant was appointed in 1907 for the purpose of making and looking after this proposed collection.

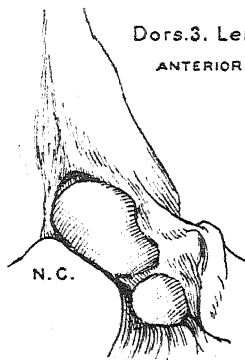
takes place abruptly and sharply at the articulation between dors. 1 and dors. 2. Occasionally a trace of the lateral process is retained on the posterior surface of dors. 1, as shown in text-fig. 62, *l.z.p.* on dors. 1. In the Pigs and the Hippopotamus the same is the case.

Text-fig. 70.

Dors 2 Left side  
POSTERIOR FACE.



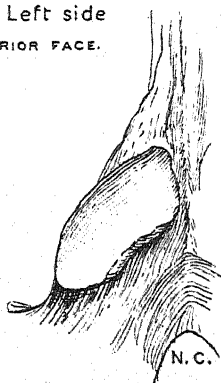
Dors.3. Left side  
ANTERIOR FACE.



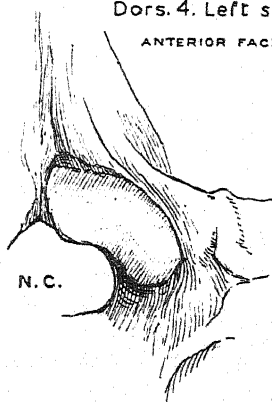
Similar drawing, to show the duplicate facets connecting Dorsal 2 and Dorsal 3 in the same animal.  $\frac{2}{3}$  nat. size.

Text-fig. 71.

Dors.3. Left side  
POSTERIOR FACE.



Dors. 4. Left side  
ANTERIOR FACE.



Similar view, to show the single facets (now the median not the lateral factor) connecting Dorsal 3 and Dorsal 4 in the same animal.  $\frac{2}{3}$  nat. size.

In Tapir and Horse the articulation between dorsal 1 and dorsal 2 does *not* exhibit an abrupt change, but the facets are intermediate in position to those shown in the joints in front and behind.

In the Carnivora (Cats, Dog, and Fox) the break occurs at the joint between dorsal 2 and dorsal 3: the anterior joint (that between dorsal 1 and dorsal 2) resembling that of the cervicals.



## 3. Some Australasian Spiders.

By H. R. HOGG, M.A., F.Z.S.

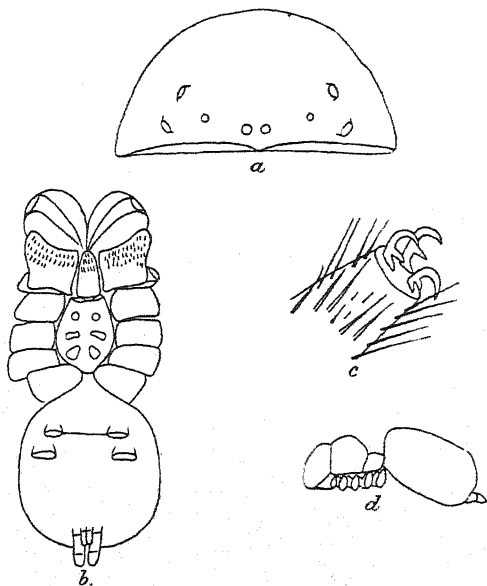
[Received March 16, 1908.]

(Text-figures 72-75\*.)

Genus *MISSULENA* Walck.*MISSULENA* (*ERIODON*) *OCCATORIA* Walck.

Mr. W. J. Rainbow, F.L.S., of the Australian Museum, Sydney, was good enough to send me a female of the above genus, one of three found by him at Enfield, a suburb of Sydney.

Text-fig. 72.

*Missulena occatoria* Walck.

a. Eyes from above.

b. Under side of body.  $\times 2$ .

c. Tarsal claws.

d. Profile. Nat. size.

This agrees so closely with the description given by M. Lucas in 1865 (Ann. Soc. Ent. Fr. ser. 4, vol. v. p. 309, pl. 8) of the specimen identified by him as the above, the type species of the genus, by comparison with Walckenaer's original type, that I have no doubt of its being the same.

I give the following particulars as so little is known of the species; and as the two specimens (the type and M. Lucas's)

\* NOTE.—The figures given in the eye-diagrams are  $\frac{1}{10}$  millimetre.

formerly in the Museum of the Jardin des Plantes, Paris, have disappeared, this is probably the only specimen in Europe now available for reference.

The cephalothorax, mandibles, legs, and palpi are uniformly dark red-brown, smooth and shiny, the abdomen dark yellow-brown. The thoracic fovea is long, deep and procurved, and three deep radial indentations on either side of the thoracic part.

The four lateral eyes and front median pair are of the same size \* (3), the laterals being raised, the medians sessile, their diameter apart. The intermediate row sessile and slightly smaller than the others ( $2\frac{1}{2}$ ). They lie just above the level of the front row, which is straight and two-thirds of an eye-breadth from the margin of the clypeus. The distance between the posterior laterals is 43; between anterior and posterior laterals at each side 8; between the posterior laterals and intermediates at each side 9; between the intermediates 28; between the intermediates and the anterior median at each side  $10\frac{1}{2}$ ; and between the anterior laterals and the medians at each side 20.

The rastellum consists of three rows of short stout spines. On the inner margin of the falkx-sheath are about 9 large teeth. A few small intermediate and two large teeth, with thick fringe, on the outer margin.

There are numerous club-shaped spines on the fore part of the lip and on the maxillae; the latter very square with a protuberance on the outer upper corner. The lip is rounded in front and twice as long as broad.

The sternal sigillae are large and away from the margin.

The legs are short and stout. The three tarsal claws and female palp-claw are short, stout and well curved, with one long tooth near the base in each.

The abdomen is oval, high, slightly overhanging the cephalothorax, and thickly covered with smooth downlying hair. The spinnerets are short, the first joint of the superior pair is twice the length of the second; the inferior pair are as long as the second joint of the superior.

The measurements (in millimetres) are as follows:—

		Long.	Broad.		
Cephalothorax ...		$8\frac{1}{2}$	$\left\{ \begin{array}{l} 8 \text{ in front.} \\ 9 \end{array} \right.$		
Abdomen .....		13		11	
Mandibles .....		$\left\{ \begin{array}{l} 3\frac{1}{2} \text{ horizontally.} \\ 6\frac{1}{2} \text{ vertically.} \end{array} \right.$		4 broad each.	
		Trochanter Patella Metatarsus			
		Coxa.	& femur.	& tibia. & tarsus.	
Legs .....	1.	$3\frac{1}{2}$	6	5	$4\frac{1}{2}$ = 19
	2.	$3\frac{1}{2}$	6	5	$4\frac{1}{2}$ = 19
	3.	$3\frac{1}{2}$	$6\frac{1}{2}$	5	5 = 20
	4.	$3\frac{1}{2}$	8	6	= $23\frac{1}{2}$
Palpi .....	3	5	$4\frac{1}{2}$	$2\frac{1}{2}$	= 15
Superior spinnerets .....		$1\frac{1}{2}$ , $\frac{3}{4}$	= $2\frac{1}{4}$ . Inferior $\frac{3}{4}$ .		

\* The figures are tenths of a millimetre.

These leg measurements are correct; they do not agree with L. Koch's, but he did not have a specimen and does not give his authority.

### Genus *HEXATHELE* Ausserer.

Our knowledge of the small and little-known genus *Hexathele*, whose sole habitat lies in New Zealand, has recently been added to by two specimens from Auckland sent to the British Museum by the Rev. W. H. Webster; these and some others herein referred to, by the courtesy of Mr. A. S. Hirst, in charge of the collection of Arachnida, I have been able to examine.

The want of precision in the descriptions of some of the known specimens from different localities seemed at one time to render it doubtful whether they were really different from the type species *H. hochstetteri* Auss., of which the locality is only known as New Zealand; but, on revising those I have been able to see, with what has been written about others, I think it may now be taken that there are four separable species. Mr. Goyen's *H. petreii* from Otago is certainly very like the type species, but he specifies three points which if correctly described will make his species good. The male and female described by myself (Proc. Zool. Soc. 1901, p. 276) from Pahiatua, Wellington, N.Z., as *H. hochstetteri*, will form another, and I now record it as *Hexathele huttoni*, sp. n., after the sender the late Capt. Hutton. Those of Mr. Webster's are a fourth. They may be distinguished as follows:—

- a. Front median eyes one half their diameter apart.  
Cephalothorax longer than patella cum tibia iv. .... *H. huttoni*, sp. n.
- b. Front median eyes their diameter apart.  
Cephalothorax not longer than patella cum tibia iv.
  - a<sup>1</sup>. Front median eyes the same distance from the front side eyes as from one another.
    - a<sup>2</sup>. Front and rear rows of eyes of equal length; no spines on femoral or patellar joints of legs (sec. L. Koch).  
Cephalothorax shorter than patella cum tibia iv. ... *H. hochstetteri* Auss.
    - b<sup>2</sup>. Rear row of eyes shorter than front row; spines on femoral and patellar joints of all legs (sec. Goyen).  
Cephalothorax as long as patella cum tibia iv. .... *H. petreii* Goyen.
  - b<sup>1</sup>. Front median eyes not more than half their diameter from side eyes of same row. Cephalothorax shorter than patella cum tibia iv. .... *H. websteri*, sp. n.

The description of *H. huttoni* I have already furnished (*loc. cit.*) and now append that of *H. websteri*.

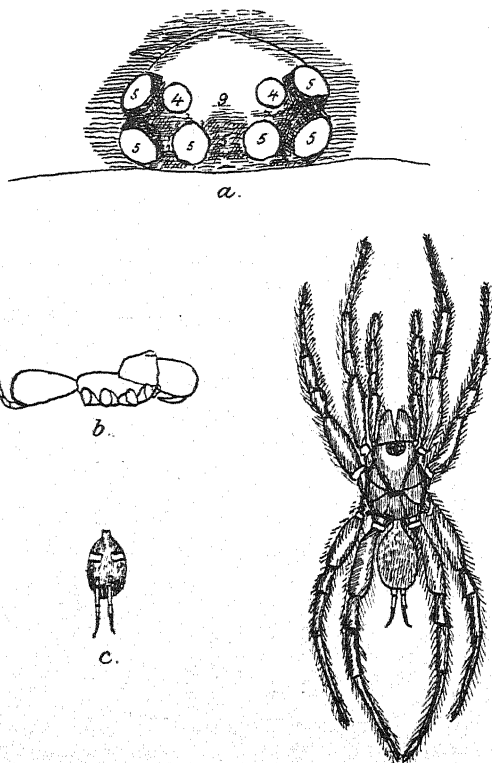
#### *HEXATHELE WEBSTERI*, sp. n.

Cephalothorax pale yellow-brown, almost bare, with a few short brown hairs at sides, slightly darker in the depressions and dark brown between the eyes. The mandibles are red-brown with long brown bristles on the inner side. Fangs black-brown. Pale orange fringes.

Maxillæ, lip, sternum, legs, and palpi yellow-brown. Abdomen yellow-brown, thinly covered with yellow-brown downlying hairs, longer and darker brown anteriorly; no discernible pattern. Hairs on under side darker yellow-grey, spinnerets the same.

The cephalothorax is flat, nearly bare, only slightly shorter than patella *cum* tibia iv., 2 mm. longer than broad; three side streaks; the transverse depression at end of cephalic part deep, short, and recurved; sides slightly rounded. The head part is all clearly raised above the thoracic, highest in front, and the eyes on a raised hillock about twice as long as broad. The first row of eyes is straight when seen from above but clearly procurved viewed from in front; the side eyes being almost close to the margin of the clypeus. The middle eyes of the front row are their diameter apart and half that distance from the side eyes and rear middle. The rear row is recurved; the oval laterals being as large as the same of the front row. The middle eyes of the rear row are nearly round.

Text-fig. 73.

*Hexathele websteri*, sp. n.

a. Eyes. | b. Profile. | c. Under side of abdomen.

The mandibles are prominent, longer than front patellæ without rastellum; a row of eleven large and two smaller teeth on inner

side of falk-sheath, a thick fringe on outer, and a median row of 6 or 7 quite small teeth at lower end.

The lip is broader than long, slightly hollowed in front, with a moderate number of dark brown short club-shaped spines in front. The latter also occur on inner lower corner of maxillæ; on the upper inner corner is a rounded apophysis. Light yellow-brown upstanding hair on both maxillæ and lip.

Sternum longer than broad, hollowed in front and pointed at rear end. Two moderately large sigillæ in hollow by lip, and three smaller each side nearly marginal.

The abdomen is oval. The superior spinnerets two-thirds the length of metatarsus of fourth pair of legs, tapering and rather divergent; the third pair of spinnerets being situated in a line with them just at their base, and the median pair lying between them.

The first, second, and third pairs of legs are of equal length. Eight or nine small teeth lie slopingly across the superior claws; inferior claws without teeth.

There are no scopula on any of the legs in the female.

This would appear to differ from *H. hochstetteri* Ausserer, besides being a good deal larger, in having the front middle eyes their diameter apart but less than half that distance from the side eyes, instead of the same distance. The row is straight instead of procurved. The lip is broader than long instead of same breadth. The superior spinnerets are only two-thirds the length of metatarsus iv. instead of (*sec. Koch*) the same length.

The measurements (in millimetres) are:—

		Long.	Broad.		
Cephalothorax ...		10½	{ 6 in front. 8½		
Abdomen ... ..		9	5½		
Mandibles .....		6			
		Coxa.	Tr. & fem.	Pat. & tibia.	Metat. & tars.
Legs .....	1.	5	9	9	9 = 32
	2.	5	9	9	9 = 32
	3.	4	8	9	11 = 32
	4.	4½	10	11½	{ 9·4 13 = 39
Palpi .....		5	6	7	4 = 22
Superior spinnerets .....		2¼	1¼	2½	= 6.

There are two females from Waiuku, Auckland, N. Z., sent by the Rev. W. H. Webster, after whom I have named them.

The following are from a small collection of Spiders forwarded to the British Museum, Nat. Hist. Dept., by the late Capt. Hutton and Mr. C. H. Tripp from Pitt Island, one of the Chatham group, some 500 miles east of New Zealand.



This includes two species of *Dolomedes* Latr., both apparently new, and I therefore describe them below. The only two species recorded from New Zealand are nearest to them in the genus.

L. Koch (Die Arach. Austr. vol. ii, p. 858) makes the following synopsis of his Australian and New Zealand species:—

A. Cephalothorax longer than tibia iv.

α. ....

β. Eyes of second row markedly larger than the middle eyes of first row.

α<sup>1</sup>. No scopula on legs.

β<sup>1</sup>. The legs furnished with a scopula.

α<sup>2</sup>. Third pair of legs shorter than the second.

α<sup>3</sup>. Scopula on front two pairs only (sec. Koch).

(I will add) Eyes of 2nd and 3rd rows of equal size ... *D. minor*, L. K.

β<sup>3</sup>. Scopula on all legs. Eyes of 2nd row clearly larger than those of 3rd. (from New Zealand).

α<sup>4</sup>. Scopula on tarsi and metatarsi. Mandibles as long as front patella. Eyes dingy brown or black. Hair on abdomen upstanding, rough and coarse .....

*D. huttoni*, sp. n.

β<sup>4</sup>. Scopula on tarsi only. Mandibles longer than front patella. Eyes bright topaz-yellow. Hair on abdomen downlying, smooth and fine .....

*D. trippi*, sp. n.

β<sup>2</sup>. Second and third pairs of legs of equal length.

Scopula on all tarsi and metatarsi (sec. Koch). *D. imperiosus* L. K. (from New Zealand).

#### DOLOMEDES HUTTONI, sp. n.

The cephalothorax is dark red-brown with short, smooth, yellow-brown hair, paler and more bristly round the margin and on the eye-space. The mandibles, lip, and maxillæ black-brown, with rather long upstanding brown hair and light red fringes.

Sternum and coxæ somewhat lighter brown, with thick yellow-brown hair and some upstanding dark brown hair mingled therewith.

Legs and palpi red-brown, thickly covered with yellow-brown hair. Abdomen above brown with dark yellowish-brown hair. A paler median longitudinal stripe on anterior half and two pairs of dark muscle-spots, followed by five transverse corrugations, the last close to posterior end. On under side thick rough yellow-brown hair, with a depressed shield pattern on which are two darker narrow longitudinal lines.

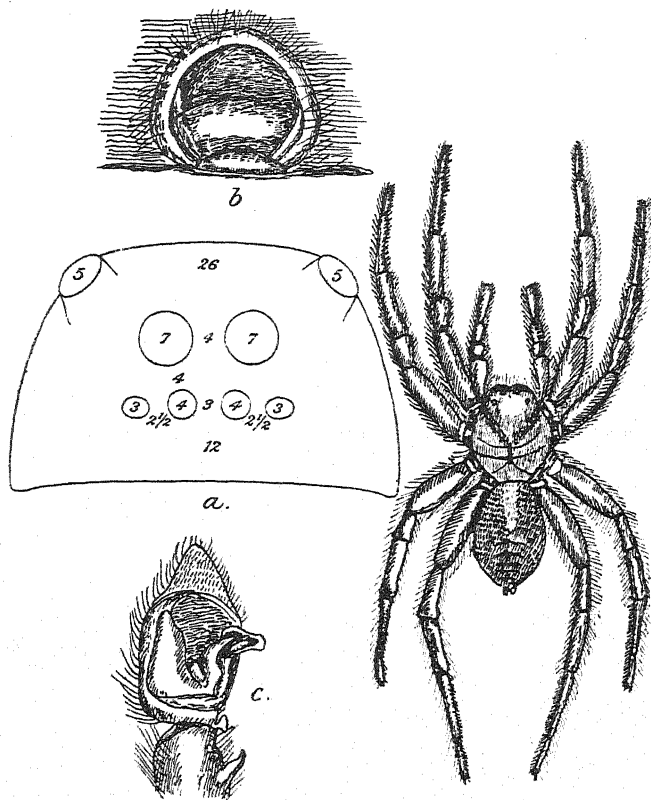
The cephalothorax is rounded at the sides, the cephalic part only slightly raised up; a long deep longitudinal fovea and well-marked side stripes on the thoracic part. The eyes of the second row are not quite twice the diameter of the front median, from which and from one another they are the latter's diameter distant. The front laterals are three-quarters the diameter of the median which are that distance apart, side eyes from middle rather less. The oval eyes of the third row are smaller than those of the second, but larger than the front median.

The margin of the clypeus is three diameters of the front median eyes distant from them.

The mandibles are kneed at the base and as long as the patella of the front pair of legs; on the inner margin of the falx-sheath are four large teeth, and on the outer margin one large between two small teeth and a thick fringe.

The lip is as broad as long, straight in front, and rounded at the sides, about half the length of the maxillæ, which are well rounded on the outer side and upper half.

Text-fig. 74.

*Dolomedes huttoni*, sp. n. Female.

a. Eyes \*. | b. Epigyne. | c. Male palp.

The abdomen is straight in front, broadest two-thirds of its length down and rounded at posterior end; the hair coarse and rough.

\* The figures are tenths of a millimetre; the figure 26 between the oval eyes of the third row should be 30.

The legs are stout with scopula on all the tarsi and metatarsi, on the under side of which latter are long powerful spines. There is one spine on tibia iv. above, none on the others. The rather long superior claws have about 7 short pectinations. The inferior claw is bare.

The palpi have tibial joint slightly longer than the patella and the anterior end of the distal joint is rather club-shaped.

The measurements of the female (in millimetres) are as follows. The male is rather smaller.

		Long.		Broad.		
Cephalothorax	...	13½		{ 5 in front. 10½		
Abdomen	.....	14½		10		
Mandibles	.....	6				
		Coxa.	Tr. & fem.	Pat. & tib.	Metat. & tars.	
Legs	.....			{ 5½ 7½		
	1.	4½	11	13	12	= 40½
	2.	4½	10½	12½	11½	= 39
	3.	4	10	12	11	= 37
	4.	4½	13	14	14	= 45½
Palpi	.....	2½	6	5	5	= 18½

There are nine females and seven males (nearly all immature) from Pitt Island (Chatham Islands).

I have named the species after the late Capt. Hutton of Christchurch, who forwarded these specimens to England.

#### DOLOMEDES TRIPPI, sp. n.

The cephalothorax is dark yellow-brown with pale yellow down-lying hair. In the female there are lateral longitudinal stripes between the median line and the margin but none at the margin. The eyes are bright topaz-yellow.

The mandibles are black-brown with thin upstanding brown hair and yellow-brown fringes. The lip and maxillæ are lighter brown with brown upstanding hairs; the sternum paler with yellowish-brown hair.

The legs and palpi are lighter brown, with upstanding brown and downlying pale yellow-brown hairs.

The abdomen above is thickly covered with smooth downlying pale yellow-brown hair mottled with dark grey. The sides are darker, and a long narrow median space underneath is darker still.

The head part of the cephalothorax is rather prominent.

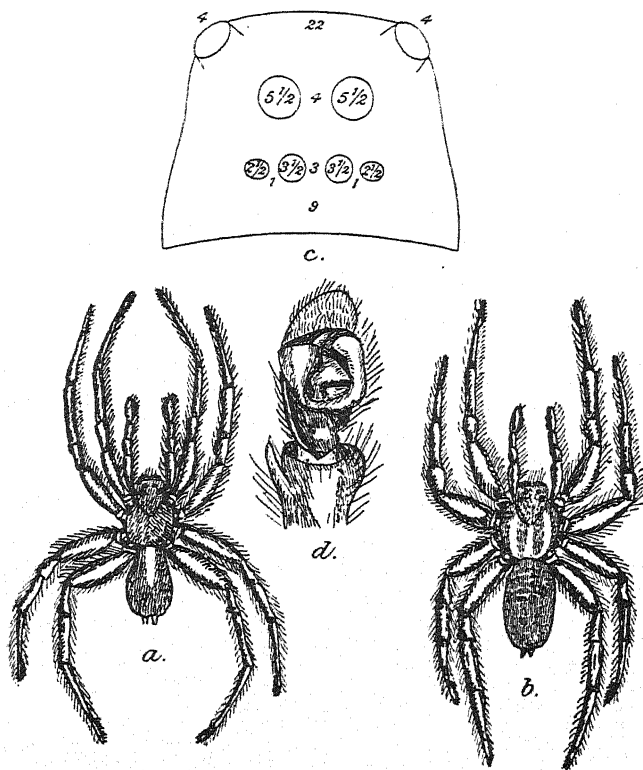
The clypeus is not quite so broad as the two front median eyes and the space between them, which latter is rather less than their diameter. The side eyes are smaller and nearly close up to the former. The eyes of the middle row are half as wide again as the front median, being rather farther from them than the diameter of the latter and the same distance from one another.

The oval eyes of the third row are in their long diameter smaller than those of the second row but larger than the front median.

The mandibles are longer than patella of front pair of legs, they are stout and kneed at the upper half. There are four large teeth on the inner margin of the falx-sheath, one large between two small teeth and a thick fringe on the outer margin.

The lip is broader than long, rounded in front, and half the length of the maxillae.

Text-fig. 75.

*Dolomedes trippi*, sp. n.

a. Male. | b. Female. | c. Eyes. | d. Male palp.

The abdomen is somewhat cylindrical, straight at the sides and rounded at front and rear. The spinnerets small and quite terminal.

The legs are stout; the first and second pairs are equally long in the female, but in the male the first pair is the longer of the two.

There are scopula on the tarsi of all legs. One spine above on tibia iv.

Besides being larger this species differs from *D. minor* L. Koch, to which it is rather close, in having scopula on all the tarsi, instead of on the front two pairs only, in its mandibles longer than instead of equal to the front patella. The patellar joint of palpi equal to instead of shorter than the tibial; and the clypeus more than twice as broad as the distance between the front median and second row eyes, instead of only slightly more.

The measurements (in millimetres) are as follows:—

		Female.							
		Long.		Broad.					
Cephalothorax ...		9		{ 4 in front. 8					
Abdomen .....		13		7					
Mandibles .....		4½							
		Coxa.	Tr. & fem.	Pat. & tib.		Metat. & tars.			
Legs .....	1.	3	9	{ 3½ 6½ 10		9	=	31	
	2.	3	9	{ 10		9	=	31	
	3.	2½	9	{ 9		8½	=	29	
	4.	3	10	{ 10		10	=	33	
Palpi .....	2	5	4	{ 3½		3½	=	14½	

				Male.					
		Long.		Broad.					
Cephalothorax ...		9		{ 3¾ in front. 6½					
Abdomen .....		9		5½					
Mandibles .....		4		longer than front patella.					
		Coxa.	Tr & fem.	Pat. & tib.		Metat. & tars.			
Legs .....	1.	3	9½	11		11	=	34½	
	2.	3	9	10½		10½	=	33	
	3.	2½	9	9½		9½	=	30½	
	4.	3	10	11		12	=	36	
Palpi .....	2	6	4	4		4	=	16	

There are one male and one female from Pitt Island. I have named them after C. H. Tripp, Esq., by whom they were collected.

April 28, 1908.

DR. HENRY WOODWARD, F.R.S., Vice-President,  
in the Chair.

The Secretary read the following report on the additions made to the Society's Menagerie during the month of March 1908:—

The number of registered additions to the Society's Menagerie during the month of March was 147. Of these 103 were acquired by presentation, and 17 purchased, 9 were received on deposit, 8 by exchange, and 10 were born in the Gardens.

The number of departures during the same period, by death and removals, was 178.

Among the additions special attention may be directed to:—

A pair of Jaguars (*Felis onca*), from Northern Paraguay, purchased on March 21st.

Two Bay Lynxes (*Felis rufa*), from North America, purchased on March 28th.

Two Himalayan Ibexes (*Caprasibirica*), from Panginear Chamba, presented by H.H. The Maharajah of Chamba on March 27th.

A Red Brocket (*Mazama rufa*) and a Savannah Deer (*Odocoileus americanus savannarum*), from Venezuela, presented by A. Pam, Esq., F.Z.S., on March 25th.

A Collection of thirty-one birds, including two Red-tailed Guans (*Ortalis ruficauda*), an Ochre-winged Dove (*Leptoptila ochroptera*), and two White-necked Saltators (*Saltator albicollis*), new to the Collection, from Venezuela, presented by A. Pam, Esq., F.Z.S., on March 25th.

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Mr. C. Tate Regan, M.A., F.Z.S., exhibited a specimen of an Australian Cat-fish (*Cnidogobius megastoma* Richards.), dissected from one side to show the supports of the vertical fins, and made the following remarks:—

“In Teleostean Fishes the rays of the caudal fin are inserted directly on the more or less expanded hæmal spines of the posterior vertebræ, which are generally fused to form a hypural bone; sometimes a few procurent rays above and below are supported by the neural and hæmal spines of the vertebræ preceding the hypural. The dorsal and anal fins differ from the caudal in that each ray is inserted on one of a series of basal supports, the so-called interneural and interhæmal spines.

“The Siluroid Fishes of the sub-family Plotosinæ have been generally defined as having two dorsal fins, a short anterior one and a longer posterior fin continuous with the caudal, similar to the long anal. The so-called second dorsal fin proves to be a procurent portion of the caudal fin, which has extended forward along the back and in the species exhibited has a base of more than  $\frac{2}{3}$  the total length of the fish and is formed of about 130 rays;

these are supported directly by the neural spines, in striking contrast to the externally similar anal fin, the rays of which are attached to a series of interhæmals."

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Mr. Henry Scherren, F.Z.S., exhibited on behalf of Mr. Walter Burton, F.Z.S., some melanistic and black leopard skins, presented to Mr. Clarkson Williams in Abyssinia, where they were obtained. The melanistic skins showed a deepening of ground-colour, especially along and on each side of the median dorsal line. In the black skins, of which two were shown, traces of markings were visible in certain lights, and the melanism appeared to be due to a deepening of the ground, not to a multiplication of the spots. Mr. Scherren stated that black skins from the same locality had been received by Mr. Rowland Ward, and, like these, made up into rugs. Mr. Ward, however, had preferred not to exhibit till he could procure skins obtained by a European sportsman.

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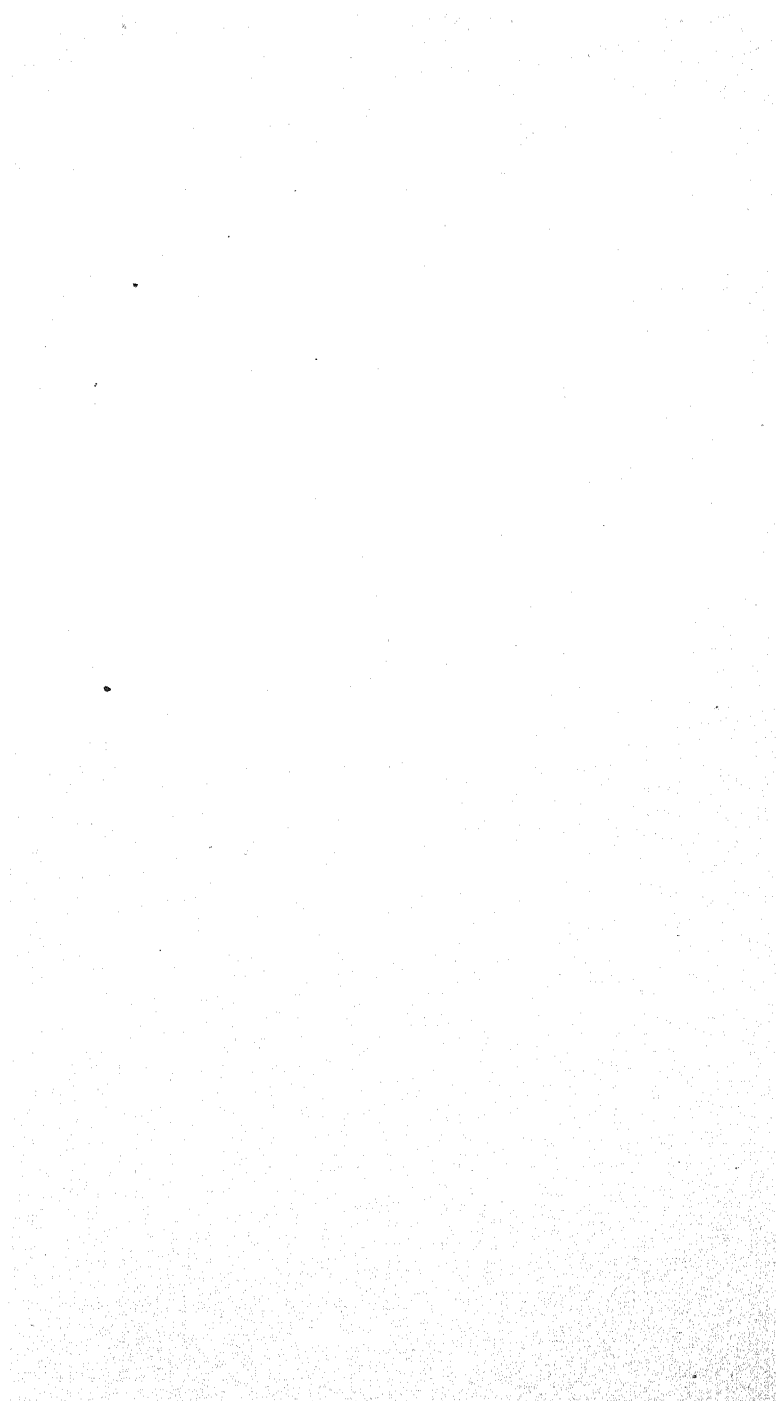
Prof. D'Arcy Wentworth Thompson, C.B., F.Z.S., read a paper entitled "On the Shapes of Eggs"\*, which contained a discussion of the physical causes to which may be ascribed the various forms assumed by the eggs of Birds and other animals. The egg, prior to the formation of the hard shell, is a fluid body enclosed in a somewhat elastic membrane. Its form tends to be spherical, but is liable to distortion by the peristaltic pressure of the oviduct. From the nature and direction of the peristaltic wave, compression will be likely to occur in the posterior part of the egg, rendering it broader in front than behind; and it may be shown mathematically that the form of the envelope or surface of the egg will correspond to the formula

$$p^n + T\left(\frac{1}{r} + \frac{1}{r'}\right) = P,$$

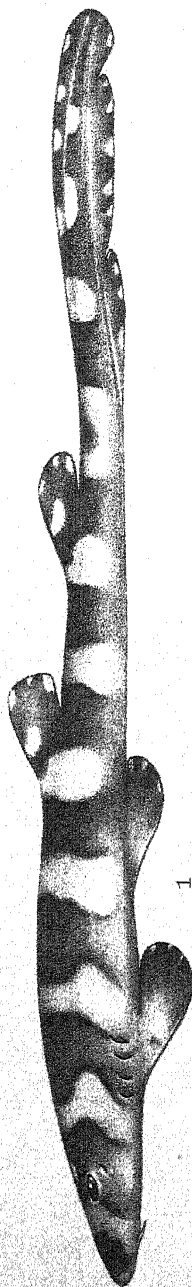
where  $p^n$  is the normal component of external pressure at a point where  $r$  and  $r'$  are the radii of curvature,  $T$  is the tension of the envelope, and  $P$  the internal fluid-pressure. It may further be shown mathematically that, after the egg is formed, its unsymmetrical shape, with a blunt anterior end and a tapering posterior one, is well adapted for its easy transference through the oviduct, blunt end foremost. The yolk, surrounded by its own proper membrane, remains approximately spherical whatever be the form of the egg-shell: because there lies between the two a fluid (viz. the white of the egg) which makes the pressure ( $p^n$ ) upon the yolk practically constant.

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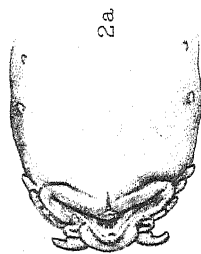
\* Published in 'Nature,' vol. 78. p. 111 (1908).



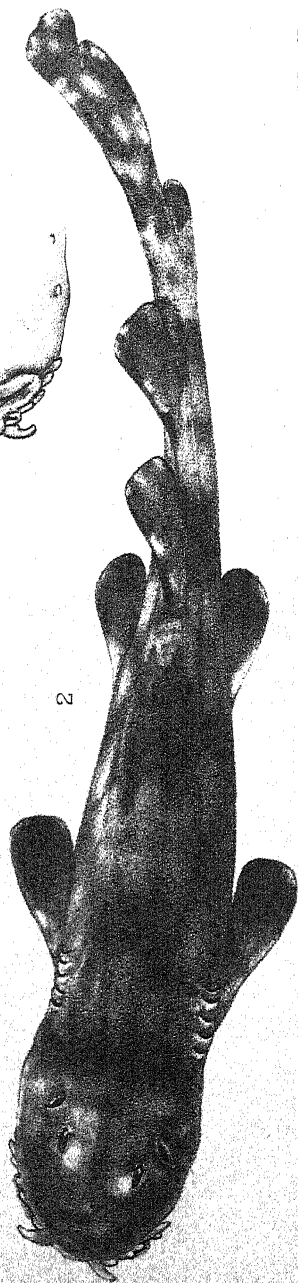




1



2a



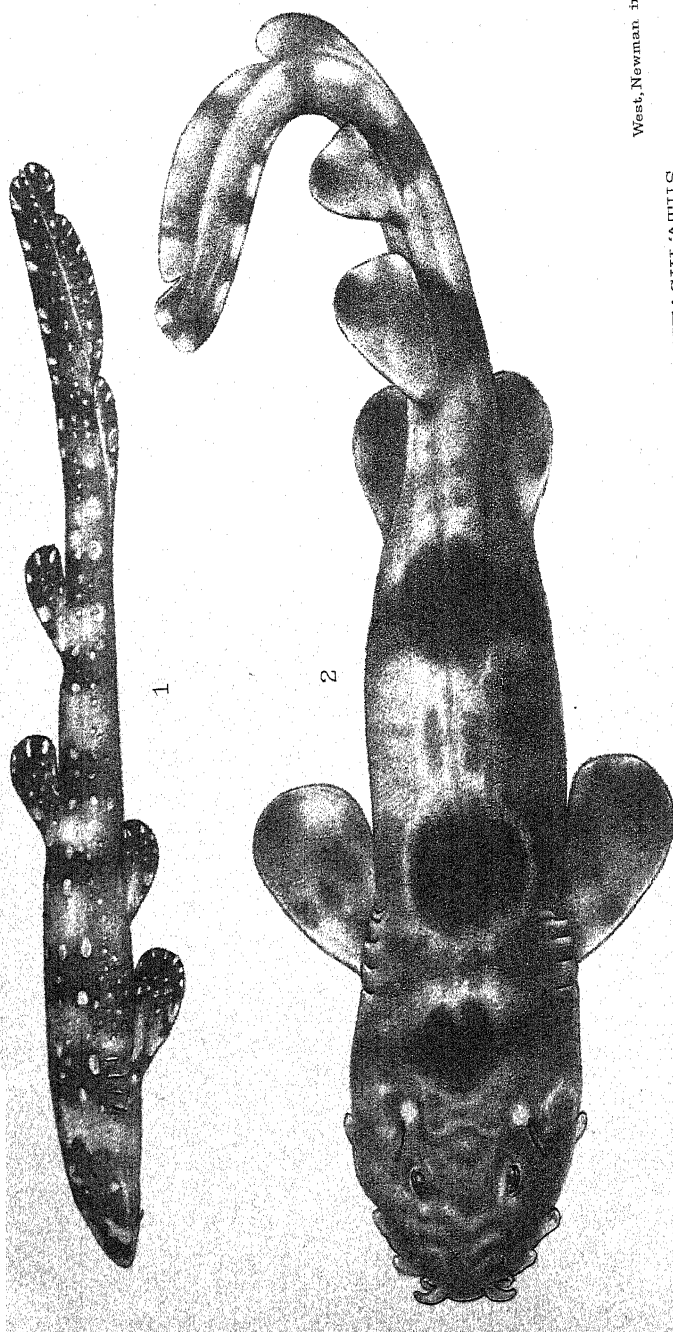
2

G. M. Woodward del. lith.

1. *CHILOSCYLLIUM* GRISEUM. 2. *ORECTOLOBUS* ORNATUS.

West, Newman imp.



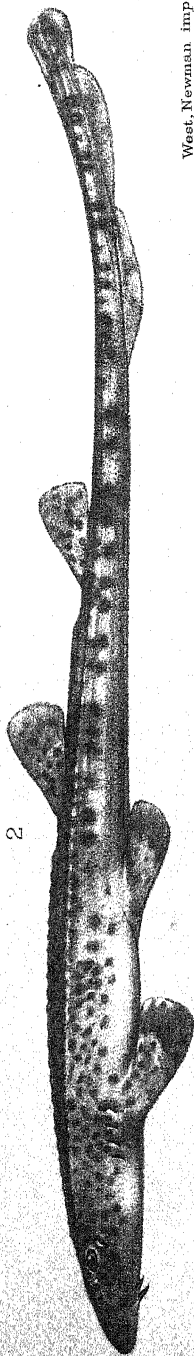
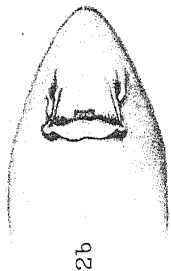
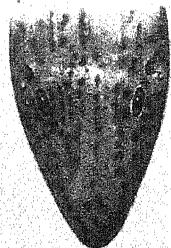


1. CHILOSCYLLIUM PLAGIOSUM. 2. ORECTOLOBUS TENTACULATUS.

G. M. Woodward del. et lith.

West, Newman imp.





G. M. Woodward del. et lith.

1. CHILOSCYLLIUM GRISEUM. 2. CHILOSCYLLIUM INDICUM.

Weest, Newman imp.

The following papers were read:—

1. A Revision of the Sharks of the Family *Orectolobidæ*.

By C. TATE REGAN, M.A., F.Z.S.

[Received April 1, 1908.]

(Plates XI.-XIII.\*)

This revision of the *Orectolobidæ* was prepared some time ago as part of a descriptive catalogue of the Selachians in the British Museum, a work which I have had no opportunity of continuing for more than two years. I have therefore thought it best to publish some of those parts which are ready.

The suborder Galeoidei includes Sharks with an anal and two dorsal fins, without fin-spines and with five gill-openings on each side. There are five families, viz. *Odontaspididæ*, *Lamnidæ*, *Orectolobidæ*, *Scyliorhinidæ*, and *Carchariidæ*. The *Orectolobidæ* are distinguished by the presence of oro-nasal grooves †, by having the last two to four gill-openings above the base of the pectoral, and by the posterior position of the dorsal fins, the first of which is above or behind the pelvics. Anatomically they differ notably from the other Galeoidei in having the mesopterygium expanded distally and bearing nearly as many radials as the metapterygium and in the reduction or absence of the triradiate cartilaginous rostrum.

In the present revision twenty-one species are recognised and are referred to eight genera; most of the species are from the Indo-Pacific.

The considerable range of variation in physiological characters

\* For explanation of the Plates, see p. 364.

† In most Selachians the nasal cavities are separate from the mouth. In three species of *Scyliorhinus* (*S. canicula*, *S. edwardsii*, and *S. marmoratum*) the nasal cavities are so near the mouth that the large anterior nasal valves overlie the edge of the upper lip, but there are no oro-nasal grooves. In the *Raidæ* oro-nasal grooves are present, but run to the corner of the mouth and do not divide the upper lip. In the *Cestraciontidæ* and *Orectolobidæ* the oro-nasal grooves divide the upper lip into a median and two lateral portions; they thus correspond in position to the embryonic oro-nasal grooves of the Amniote Vertebrates.

Most text-books of embryology lay some stress on the presence in Amniote embryos of these grooves, which are supposed to represent an ancestral condition found in the adults of a lower group, the Selachians. There can be little doubt, however, that in the Selachians oro-nasal grooves are specialised structures which have arisen independently in different families, none of which can be regarded as in any way approximating to the ancestral type of the higher vertebrates.

It is now generally accepted that the Amniote Vertebrates are derived from the Batrachians and the latter from the Crossopterygian fishes. In all these groups the præmaxillary and maxillary bones form the upper border of the mouth and separate the external apertures of the oral and nasal cavities. In the Crossopterygians there are no internal nares; in the Batrachians internal nares are present and develop as perforations of the palate, and in the Amniota they are the persistent inner ends of the embryonic oro-nasal grooves. It seems more likely that in this case ontogeny repeats phylogeny in the Batrachians rather than in the Amniota; if communication between the oral and nasal cavities internal to the præmaxillaries and maxillaries originated as open grooves, such grooves must have been present before the development of the præmaxillaries and maxillaries, but this is improbable, as the Crossopterygians have the bones of the upper jaw fully developed, but no trace of internal nares or oro-nasal grooves.

in the sharks of this family is of some interest, and may be exemplified by comparison of two extreme types.

*Rhinodon typicus* is a large pelagic shark, with numerous small teeth, long gill-rakers, minute spiracles, and wide gill-openings; the pectoral fins are acutely pointed, and the axis of the caudal fin is so strongly turned upwards and the lower lobe is so much produced anteriorly as to give the appearance of a deeply forked symmetrical fin. The resemblances of this shark to the Basking Shark (*Cetorhinus maximus*), which belongs to the family Lamnidae, are very striking.

*Eucrossorhinus dasypogon* is a ground-shark with strong dentition, large oblique spiracles, and small gill-openings; the head and anterior part of the body is strongly depressed and fringed with dermal flaps; the pectoral fins are broad and obtuse and the axis of the caudal fin is not directed upwards nor is the lower lobe enlarged. This form shows many points of similarity to the Angel-fishes (*Squatina*), which belong to another suborder.

In some species (e. g. *Chiloscyllium punctatum*, *C. griseum*, and *Stegostoma tigrinum*) there is considerable variation in colour and markings, partly due to changes which take place during growth. The young of these species have dark cross-bars, which may become replaced by spots or may disappear, giving rise to a uniform coloration.

As a rule the pelagic forms (e. g. *Ginglymostoma*, *Rhinodon*) have no conspicuous markings; the littoral sharks (*Parascyllium*, *Brachaelurus*, *Chiloscyllium*, *Stegostoma*) are spotted, banded, or variously ornamented, the coloration being most brilliant in the tropical species; whilst the ground-sharks (*Orectolobus*, *Eucrossorhinus*) have markings which probably resemble the rocks and weeds among which they lurk.

In the *Orectolobidae*, as in other sharks, the dorsal and anal fins appear to be comparatively larger in the young than in the adult.

### *Synopsis of the Genera.*

- I. Spiracles very small; anal quite distinct from the caudal, wholly or partly opposed to the second dorsal.

A. Origin of second dorsal behind that of the anal ... 1. *Parascyllium*.

B. Origin of second dorsal above or in advance of that of the anal.

Teeth tricuspid or multicuspid ..... 2. *Ginglymostoma*.

Teeth unicuspid ..... 3. *Rhinodon*.

- II. Spiracles well-developed; anal either continuous with the caudal or terminating directly in front of it.

A. Lower lip divided into two by a symphyseal groove.

1. Sides of head and snout without dermal flaps; spiracle surrounded by a circular raised rim ... 4. *Brachaelurus*.

2. Sides of head and snout more or less strongly fringed with dermal flaps; spiracles wide oblique slits.

Last two gill-openings closer together than the rest ..... 5. *Orectolobus*.

Gill-openings equidistant ..... 6. *Eucrossorhinus*.

B. Lower lip not divided by a symphyseal groove.

Caudal fin of moderate length ..... 7. *Chiloscyllium*.

Caudal fin very elongate ..... 8. *Stegostoma*.

## 1. PARASCYLLIUM.

*Parascyllum* Gill, Ann. Lyc. N. York, 1861, p. 412; Günth. Cat. Fish. viii. p. 410 (1870).

Head rather elongate; body very elongate, subcylindrical. Mouth slightly arched, near the end of the snout; teeth small, pointed, with or without accessory cusps; lower lip not divided by a symphyseal groove. Nasal valves separate, each with an obtuse cirrus. Eye small; a longitudinal fold below the eye. Spiracles very small, below the level of the eyes and posterior to them. First four gill-openings of moderate width; last considerably wider; last two close together and above the base of pectoral. Dorsal fins subequal, the first behind the pelvics, the second in part posterior to the anal, which terminates at a considerable distance from the caudal. Caudal of moderate length; axis scarcely directed upwards; lower lobe notched posteriorly. Pectorals broad, rounded.

Two species from Australia.

## 1. PARASCYLLIUM COLLARE.

*Parascyllum variolatum* (non Dumeril) Günth. Cat. Fish. viii. p. 410 (1870).

*Parascyllum collare* Ramsay & Ogilby, Proc. Linn. Soc. N. S. Wales, (2) iii. 1889, p. 1310; Waite, Mem. Austral. Mus. iv. 1899, p. 32, pl. ii. fig. 2.

No dorsal keel. Mouth near the end of snout; fold of lower lip broadly interrupted; nasal cirrus short. First dorsal originating above the posterior edge of pelvics; free edge of the fin straight or convex; length of base  $\frac{3}{4}$  the distance from second dorsal, which originates above the posterior part of anal. Anal longer than deep, its base rather longer than that of either dorsal, but shorter than its distance from the caudal. Brownish above, yellow below; back with some broad dark transverse bars; upper parts of body and fins with round dark spots.

Coasts of New South Wales, Victoria, and Tasmania.

1. (860 mm.).

Tasmania.

M. Allport, Esq.

2. (760 mm.).

Tasmania.

## 2. PARASCYLLIUM VARIOLATUM.

*Hemiscyllum variolatum* Dumeril, Rev. et Mag. Zool. 1853, p. 121, pl. iii. fig. 1, and Elasnobr. p. 327 (1865).

*Parascyllum nuchale* MacCoy, Ann. Mag. N. H. (4) xiii. 1874, p. 15, pl. ii.

A broad blackish transverse band extending from behind the eye to the root of the pectoral, covered with small white spots; numerous white spots on the body; along the side a series of six white semicircles, which may unite to form an undulating stripe, extending from pectoral to caudal; each fin with a pair of dark spots at its free edge and one at its base. In structural characters apparently very similar to *P. collare*, but evidently distinct.

Coasts of Victoria and Tasmania.



## 2. GINGLYMOSTOMA.

*Ginglymostoma* Müll. & Henle, Arch. f. Naturgesch. 1837, i. p. 395, and Plagiost. p. 22 (1841); Günth. Cat. Fish. viii. p. 407 (1870).

*Nebrius* Rüpp. Neue Wirbelth., Fische, p. 62 (1840).

Head broad, obtuse; body elongate, subcylindrical. Mouth transverse, near the end of the snout; teeth small, tricuspid or multicuspid; lower lip not divided by a symphysial groove. Nasal valves separate, each with a cirrus. Eye small; no longitudinal fold below the eye. Spiracle very small, behind the eye. Gill-openings of moderate width; last two close together; last two or three above the base of the pectoral. First dorsal above or partly behind the pelvis; second dorsal above or partly in advance of the anal, which is free from the caudal. Caudal of moderate length; axis directed upwards; lower lobe notched posteriorly.

Four species.

*Synopsis of the Species.*

- I. Each dorsal and anal fin with the anterior angle broadly rounded; lower caudal lobe not produced anteriorly; teeth tricuspid or pentacuspoid, the middle cusp the strongest.

Origin of first dorsal opposite to that of the pelvis ...  
Origin of first dorsal slightly in advance of posterior  
end of base of pelvis .....

1. *cirratum*.

2. *brevicaudatum*.

- II. Each dorsal and anal fin with the anterior angle pointed; lower caudal lobe somewhat produced anteriorly.

Teeth with a strong median cusp and 3 or 4 small  
cusps on each side.....  
Teeth with the cusps graduated to the strongest, which  
is not median.....

3. *ferrugineum*.

4. *concolor*.

## 1. GINGLYMOSTOMA CIRRATUM.

*Squalus cirratus* Gmelin, Linn. Syst. Nat. p. 1492 (1788);  
Schneid. Bloch's Syst. Ichth. p. 128 (1801).

*Squalus punctatus* Schneid. t. c. p. 134.

*Squalus punctulatus* Schneid. t. c. p. 549.

*Squalus argus* Bancroft, Zool. Journ. v. 1834, p. 82.

*Ginglymostoma cirratum* Müll. & Henle, Plagiost. p. 13 (1841);  
Duméril, Elasmobr. p. 334 (1865); Günth. Cat. Fish. viii. p. 408  
(1870); Jord. & Everm. Bull. U.S. Nat. Mus. xlvii. 1896, p. 26,  
and 1900, pl. iv. fig. 13.

*Ginglymostoma fulvum* Poey, Mem. ii. p. 342 (1861).

*Ginglymostoma caboverdianus* Capello, Jorn. Sci. Phys. Lisbon,  
1867, p. 167.

Nasal cirrus extending to or beyond the oral edge of the nasal valve. Lower labial folds separated by a considerable interspace. Teeth bicuspid or pentacuspoid, the middle cusp much the strongest. First dorsal a little larger than the second and considerably larger

than the anal; origin of first dorsal opposite to that of the pelvics; free edge of the fin straight or convex, anterior angle broadly rounded, posterior angle nearly rectangular; length of base greater than the distance from second dorsal. Anal beginning below the middle of second dorsal; free edge of the fin evenly convex. Caudal fin  $\frac{2}{3}$  the length of the rest of the fish or rather more; lower lobe moderately deep and with the edge forming an obtuse angle anteriorly. Pectoral with nearly straight free edge and rounded angles, a little longer than broad, its length nearly equal to its distance from the mouth or  $\frac{2}{3}$  of the distance from its origin to that of the pelvics. Brownish; young with small, scattered, round, blackish spots.

Tropical Atlantic; Pacific Coast of Mexico.

1-2. (530 and 400 mm.)	St. Croix.	
3. (390 mm.)	Cuba.	Zool. Soc.
4. (280 mm.)	Jalisco, Mexico.	Dr. A. C. Buller.
5. (230 mm.)	S. America.	Sir R. Schomburgk.
6-8. (740-2400 mm.) stuffed.	W. Indies.	

## 2. GINGLYMOSTOMA BREVICAUDATUM.

*Ginglymostoma brevicaudatum* Günth. & Playfair, Fish. Zanzibar, p. 141, pl. xxi. (1866); Günth. Cat. Fish. viii. p. 408 (1870).

Nasal cirrus short, not nearly reaching the oral edge of the nasal valve. Lower labial folds separated by a considerable interspace. Teeth tricuspid or pentacuspoid, the middle cusp much the strongest. Dorsal and anal fins subequal, each with broadly rounded anterior angle, straight or slightly convex free edge, and obtuse posterior angle. First dorsal originating a little in advance of end of base of pelvics; length of base less than the distance from second dorsal. Anal beginning and ending respectively a little behind the origin and end of the base of second dorsal. Caudal fin rather less than  $\frac{2}{3}$  of the length of the rest of the fish; lower lobe deep and with the edge forming an obtuse angle anteriorly. Pectoral with nearly straight free edge and rounded angles, as broad as long, its length equal to its distance from the eye or  $\frac{1}{2}$  the distance from its origin to that of the pelvics.

Zanzibar: Seychelles.

1. (580 mm.), stuffed, type of the species.	Zanzibar.	Lieut.-Col. Playfair.
2. Skull.	Seychelles.	Swinburne Ward, Esq.
3. Jaws.		

## 3. GINGLYMOSTOMA FERRUGINEUM.

*Scyllium ferrugineum* Less. Voy. Coquille, Zool. ii. p. 95 (1830).  
*Ginglymostoma concolor* Müll. & Henle, Plagiost. p. 22, pl. vi. (1841).

*Ginglymostoma muelleri* Günth. Cat. Fish. viii. p. 408 (1870);  
PROC. ZOO. SOC.—1908, No. XXIII.

Klunz. Fisch. Roth. Meer. p. 230 (1870); Day, Fish. India, p. 725 (1878).

Nasal cirrus extending to or nearly to the oral edge of the nasal valve. Lower labial folds separated by a considerable interspace. Teeth with a strong median cusp and with 3 or 4 smaller accessory cusps on each side. First dorsal a little larger than the second or than the anal; all three with slightly concave free edge and acutely pointed anterior angle; base of first dorsal opposite to that of the pelvis, its length a little more than the distance from the second. Anal beginning below the anterior part of second dorsal. Caudal fin nearly  $\frac{1}{2}$  the length of the rest of the fish; lower lobe produced and acutely pointed anteriorly. Pectoral with slightly concave free edge and acutely pointed anterior angle, nearly twice as long as broad, its length nearly equal to its distance from the end of snout or  $\frac{2}{3}$  of the distance from its origin to that of the pelvis. Brownish.

Tropical Indo-Pacific.

Attains a length of 2400 mm.

#### 4. GINGLYMOSTOMA CONCOLOR.

*Nebrius concolor* Rüpp. Neue Wirbelth., Fische, p. 62, pl. xvii. fig. 2 (1840).

*Ginglymostoma concolor* Cant. Cat. Mal. Fish. p. 395 (1850); Günth. Cat. Fish. viii. p. 409 (1870); Klunz. Fisch. Roth. Meer. p. 232 (1870); Day, Fish. India, p. 811 (1878).

*Ginglymostoma riippellii* Bleek. Verh. Bat. Gen. xxiv. 1852, Plagiost. p. 91, and Nat. Tijds. Ned. Ind. iii. 1852, p. 83; Duméril, Elasmobr. p. 334 (1865).

Nasal cirrus extending to the oral edge of the nasal valve. Lower labial folds separated by a considerable interspace. Teeth multicuspid, the cusps subequal or graduated to the strongest, which is not the median one. First dorsal a little larger than the second or than the anal; all three with straight or slightly concave free edge and acutely pointed anterior angle; base of first dorsal opposite to that of the pelvis, its length greater than the distance from the second. Anal beginning below the anterior part of second dorsal. Caudal fin  $\frac{1}{2}$  the length of the rest of the fish; lower lobe produced anteriorly. Pectoral with slightly concave free edge and pointed anterior angle,  $1\frac{1}{2}$  as long as broad, its length equal to its distance from the mouth or  $\frac{2}{3}$  of the distance from its origin to that of the pelvis. Brownish.

Indian Ocean; Malay Archipelago.

1. (660 mm.)

Java.

Dr. P. Bleeker.

2. (700 mm.) stuffed.

Pinang.

Dr. Cantor.

#### 3. RHINODON.

*Rhineodon* (Smith) Müll. & Henle, Arch. f. Naturgesch. 1838, i. p. 84.

*Rhinodon* (Smith) Müll. & Henle, Plagiost. p. 77 (1841); Günth. Cat. Fish. viii. p. 396 (1870).

*Micristodus* Gill, Proc. Acad. Philad. 1865, p. 177.

Head broad, obtuse; body elongate, subcylindrical. Mouth transverse, subterminal; teeth very small, unicuspid, pointed, subconical, recurved; lower lip not divided by a symphyseal groove. Nasal valves separate; no nasal cirri. Eye small; no longitudinal fold below the eye. Spiracle very small, behind the eye. Gill-openings wide; last two above the base of pectoral. First dorsal above the pelvics; second dorsal above the anal, which is free from the caudal. Caudal of moderate length; axis strongly directed upwards; lower lobe considerably produced anteriorly and without posterior notch.

This genus comprises a single species, which has generally been placed in more or less close proximity to *Cetorhinus maximus*, a shark which it appears to resemble in habits and in its large size, small teeth, long gill-rakers, and wide gill-openings, as well as in the form of the caudal fin and the keeled tail. There can be little doubt, however, that *Rhinodon* is allied to *Ginglymostoma*, from which it differs in a few features of specialisation. The curious dermal keels are like those met with in other Sharks of this family, i. e. *Stegostoma*, *Chiloscyllium*.

#### 1. RHINODON TYPICUS.

*Rhinodon typicus* Smith, Müll. & Henle, Plagiost. p. 77, pl. xxxv. fig. 2 (1841); Smith, Ill. Zool. S. Afr. Fish. pl. xxvi. (1845); Duméril, Elasmobr. p. 428 (1865); Günth. Cat. Fish. viii. p. 396 (1870); Haly, Ann. Mag. N. H. (5) xii. 1883, p. 48; Thurston, Bull. Madras Mus. 1884, No. 1, pl. iii. A; Gill, Science, (2) xv. 1902, p. 824.

*Micristodus punctatus* Gill, Proc. Ac. Philad. 1865, p. 177; Günth. Cat. Fish. viii. p. 396 (1870); Jord. & Everm. Bull. U.S. Nat. Mus. xlvii. 1896, p. 52.

*Rhinodon pentalineatus* Kishinouye, Zool. Anz. xxiv. 1901, p. 694, fig.

Lower labial folds separated by a wide interspace. A median dorsal keel and on each side 2 or 3 lateral keels, the lowest of which is continued along the middle of the tail to the caudal fin. First dorsal considerably larger than the second or than the anal, its base opposite to that of the pelvics; free edge of first dorsal slightly concave, anterior angle rounded, posterior angle pointed. Second dorsal and anal equal and opposite. Lower caudal lobe strongly produced and acutely pointed. Pectoral much longer than broad, with slightly concave free edge and acutely pointed anterior angle. Head and body with round whitish spots.

This large pelagic shark has been recorded from Florida, the Cape of Good Hope, the Seychelles, Ceylon, Madras, Japan, California, Panama, and Peru.

1. Large stuffed specimen.
2. Upper jaw and snout.

Ceylon.  
Seychelles.

Colombo Mus.  
Prof. E. P. Wright.

## 4. BRACHÆLURUS.

*Brachælurus* Ogilby, Proc. Roy. Soc. Queensland, xx. 1906, p. 27.

Head broad, depressed; body elongate, somewhat depressed anteriorly, subcylindrical posteriorly. Dermal denticles small, imbricated, more or less distinctly keeled. Mouth transverse; teeth small, tricuspid; lower lip divided by a symphysial groove. Nasal valves separate, each with a cirrus. Eye small; a longitudinal fold below the eye. Spiracles moderately large, below the level of the eyes and posterior to them; each is surrounded by a raised circular rim. Gill-openings of moderate width; last three above the base of pectoral; last two a little closer together than the others. Dorsal fins subequal, the first above or behind the pelvis, the second in advance of the anal, which terminates directly in front of the caudal. Caudal of moderate length; axis not directed upwards; lower lobe notched posteriorly. Pectorals broad, with straight or convex edges and rounded angles.

A single species from Australia.

## 1. BRACHÆLURUS MODESTUS.

*Chiloscyllium modestum* Günth. Proc. Zool. Soc. 1871, p. 654, pl. liv.

*Chiloscyllium furvum* Macleay, Proc. Linn. Soc. N. S. Wales, vi. 1881, p. 364.

*Hemiscyllium modestum* Waite, Rec. Austral. Mus. iv. 1901, p. 88, fig. 9, and pl. iv. fig. 1.

No dorsal keel. Mouth nearer to level of eyes than to end of snout; fold of lower lip not continuous; nasal cirrus long, extending to posterior edge of lower lip. First dorsal originating above posterior part of base of pelvis; free edge of the fin straight; length of base greater than the distance from second dorsal. Origin of anal below the end of base of second dorsal; length of base of anal less than  $\frac{1}{3}$  that of the caudal. Pectoral extending a little more than  $\frac{2}{3}$  of the distance from its origin to that of the pelvis. Brownish, with more or less distinct darker cross-bars and, in the young, with light spots.

Coasts of Queensland and New South Wales.

- |   |               |                |
|---|---------------|----------------|
| 1. (550 mm.) stuffed, type<br>of the species. | Queensland.   |                |
| 2. (580 mm.).                                 | Port Jackson. | Imperial Inst. |

## 5. ORECTOLOBUS.

*Orectolobus* Bonap. Faun. Ital. Pesc. 7 fasc. (1834); Gill, Proc. U.S. Nat. Mus. xviii. 1895, p. 212.

*Crossorhinus* Müll. & Henle, Arch. f. Naturgesch. 1837, i. p. 396, and Plagiost. p. 21 (1841).

*Crossorhinus* (part.) Günth. Cat. Fish. viii. p. 413 (1870).

Head broad, depressed; body elongate, more or less depressed anteriorly, subcylindrical posteriorly. Dermal denticles small, imbricated or juxtaposed. Mouth slightly arched, wide, sub-

terminal; teeth slender, pointed, the median ones enlarged and unicuspid, the lateral teeth smaller, with small accessory cusps; lower lip divided by a symphysial groove. Nasal valves separate, each with a cirrus. Eye small; a more or less distinct longitudinal fold below the eyes. Spiracles large, oblique, extending forward to below the eyes. Gill-openings of moderate width, the last a little wider than the rest; last three or four above the base of pectoral; last two closer together than the others. Dorsal fins subequal, the first above or behind the pelvics, the second in advance of the anal, which terminates directly in front of the lower caudal lobe or is continuous at the base with the latter. Caudal of moderate length; axis not directed upwards; lower lobe notched posteriorly. Pectorals broad, with straight or convex edges and rounded angles.

*Synopsis of the Species.*

I. Nasal cirrus with a short branch at about the middle of its length.

A. Branch of nasal cirrus bifid; on each side 3 to 5 dermal lobes above the upper lip, followed by 4 or 5 near the angle of the mouth and these by 2 (each notched distally) at the side of the head ..... 1. *barbatus*.

B. Branch of nasal cirrus simple.

On each side 2 or 3 dermal lobes above the upper lip, followed by 3 or 4 (the first and last of which are bifid) near the angle of the mouth and these by 2 (each notched distally) at the side of the head ..... 2. *japonicus*.

Dermal lobes all simple; on each side 2 above the upper lip, 2 near the angle of the mouth, and 2 at the side of the head ..... 3. *ornatus*.

II. Nasal cirrus simple; dermal lobes simple; on each side one above the upper lip, another near the angle of the mouth, and a third at the side of the head ..... 4. *tentaculatus*.

1. *ORECTOLOBUS BARBATUS*.

*Squalus barbatus* Gmelin, Linn. Syst. Nat. p. 1493 (1788); Schneid. Bloch's Syst. Ichth. p. 128 (1801).

*Squalus lobatus* Schneid. t. c. p. 137.

*Squalus appendiculatus* Shaw, Nat. Misc. pl. DCCXXVII.

*Crossorhinus barbatus* (part.) Duméril, Elasmobr. p. 338 (1865); Günth. Cat. Fish. viii. p. 414 (1870).

*Crossorhinus barbatus* McCoy, Prodr. Zool. Vict. v. 1880, pl. xliii. fig. 1; Macleay, Proc. Linn. Soc. N. S. Wales, vi. 1881, p. 365.

A papilliform projection above the posterior part of each eye (and in the adult another above the anterior part). Nasal cirrus long, with a short bifid branch at about the middle of its length. On each side a series of 3 to 5 simple tentacle-like dermal lobes above the upper lip, followed by 4 or 5 near the angle of the mouth, the first and last of which are ramose and by 2, short, broad, and distally notched, at the side of the head. First dorsal

originating above the posterior part of base of pelvics; free edge of the fin straight, posterior angle acute or rectangular; length of base more than the distance from second dorsal, which terminates a little in advance of the origin of anal. Pectoral extending  $\frac{1}{2}$  to  $\frac{3}{4}$  of the distance from its origin to that of the pelvics. Brownish, with numerous white spots and markings, many of which form circles or enclose irregular areas.

Eastern and Southern Coasts of Australia.

- |                        |                  |                 |
|------------------------|------------------|-----------------|
| 1. (750 mm.)           | New South Wales. | G. Krefft, Esq. |
| 2. (600 mm.)           | Sydney.          | Imperial Inst.  |
| 3. (460 mm.)           | Tasmania.        | Haslar Coll.    |
| 4. (2000 mm.) stuffed. | South Australia. |                 |

## 2. ORECTOLOBUS JAPONICUS.

*Crossorhinus barbatus* (non Gmelin) Müll. & Henle, Plagiost. p. 21, pl. v. (1841); Schleg. Faun. Japon., Poiss. p. 301 (1850).

*Crossorhinus barbatus* (part.) Duméril, Elasmobr. p. 338 (1865); Günth. Cat. Fish. viii. p. 414 (1870).

*Orectolobus barbatus* Jord. & Fowler, Proc. U.S. Nat. Mus. xxvi. 1903, p. 606.

*Orectolobus japonicus* Regan, Ann. Mag. Nat. Hist. (7) xviii. 1906, p. 435.

Closely allied to *O. barbatus*, but differing in the following characters:—No papilliform projections above the eye. Nasal cirrus with a simple branch. On each side 2 or 3 simple dermal lobes above the upper lip, followed by 3 or 4 near the angle of the mouth, the first and last of which are bifid, and by 2, short, broad and distally notched, at the side of the head. Free edge of dorsal fins straight or slightly concave. Pectoral extending at least  $\frac{2}{3}$  of the distance from its origin to that of the pelvics. Yellowish, upper surface with brownish vermiculations or reticulations; back with broad dark-brown cross-bars, with yellow vermiculations.

Coasts of Japan and China.

- 1, 2. (1000 and 780 mm.) types of the species. Japan.

## 3. ORECTOLOBUS ORNATUS. (Plate XI. fig. 2.)

*Crossorhinus ornatus* De Vis, Proc. Linn. Soc. N. S. Wales viii. 1883, p. 289.

Differs from *O. barbatus* as follows:—Nasal cirrus with a short simple branch. Dermal lobes all simple, on each side 2 above the upper lip, 2 at the angle of the mouth, and 2 at the side of the head. Dorsal fins each with slightly convex free edge and rounded posterior angle. Greyish; back with dark brown cross-bars; a bar at the level of the pectorals and one in front of the first dorsal have irregular edges and each encloses a pair of ocelli; the posterior bars nearly meet in the mid-ventral line; fins with large dark spots.

Queensland.

1. (180 mm.) Australia.

4. *Orectolobus tentaculatus*. (Plate XII. fig. 2.)

*Crossorhinus tentaculatus* Peters, Monatsb. Ak. Berl. 1864, p. 123; Günth. Cat. Fish. viii. p. 414 (1870); Macleay, Proc. Linn. Soc. N. S. Wales, vi. 1881, p. 365.

A papilliform projection above the posterior part of each eye. Nasal cirrus long, simple. On each side a small simple dermal lobe above the upper lip, a larger one at the angle of the mouth, and a third at the side of the head. First dorsal originating a little in advance of the posterior end of base of pelvics; free edge of the fin straight or convex, posterior angle rounded or obtusely pointed; length of base considerably more than the distance from second dorsal, which terminates nearly above the origin of anal. Pectoral extending  $\frac{1}{2}$ – $\frac{2}{3}$  of the distance from its origin to that of the pelvics. Yellowish, back greyish; on the back, in front of the first dorsal fin, three large dark areas edged with white, continuous or subcontinuous with dark vertical bars on the sides; tail completely encircled by 3 dark vertical bands, corresponding to the two dorsal and the anal fins; fins with large dark spots.

Queensland.

1-2. (430 and 240 mm.)  
3. (220 mm.)

Cape York.

Haslar Coll.

6. *Eucrossorhinus*, gen. nov.

*Crossorhinus* (part.) Günth. Cat. Fish. viii. p. 413 (1870).

Very closely allied to *Orectolobus*, but with broader and more depressed head, smaller eyes, and wider spiracles than in any species of that genus. No longitudinal fold below the eye. Gill-openings rather small and of equal width, equidistant; last four above the base of pectoral.

A single species from Waigiou.

*Eucrossorhinus dasypogon*.

*Crossorhinus dasypogon* Bleek. Arch. Néerland. 1867, p. 400, pl. xxi. fig. 1; Günth. Cat. Fish. viii. p. 414 (1870).

Nasal cirrus ramose. Head margined by a nearly continuous series of ramose dermal flaps, extending on each side from the nasal opening to the pectoral fin; a transverse series of similar flaps behind the mouth. First dorsal originating slightly in advance of the posterior end of base of pelvics; free edge of the fin straight or slightly convex, angles rounded; length of base scarcely more than the distance from second dorsal, which terminates above the origin of anal. Pectoral extending  $\frac{4}{5}$  of the distance from its origin to that of the pelvics. Upper parts of head, body, and fins covered with a brownish network enclosing small round whitish spots; a few small dark spots on the tail, 2 or 3 on each of the pectoral and ventral fins, one on each side



at the end of the base of both dorsals and the anal, one on the anterior part of the lower caudal lobe.

Waigiou.

1. (210 mm.) type of the species.

Waigiou.

Dr. P. Bleeker.

## 7. CHILOSCYLLIUM.

*Chiloscyllium* Müll. & Henle, Arch. f. Naturgesch. 1837, i. p. 395, and Plagiost. p. 17 (1841); Günth. Cat. Fish. viii. p. 410 (1870).

*Hemisicyllium* Müll. & Henle, Arch. f. Naturgesch. 1838, i. p. 83, and Plagiost. p. 16.

*Synchismus* Gill, Ann. Lyc. N. York, 1861, p. 413.

Head obtuse; body elongate, subcylindrical. Mouth transverse; teeth small, pointed, usually with one or two pairs of small accessory cusps; lower lip not divided by a symphyseal groove. Nasal valves separate, each with a cirrus. Eye small; no longitudinal fold below the eye. Spiracles moderately large, below the level of the eyes, and usually extending forward beneath them. Gill-openings of moderate width; last three above the base of pectoral; last two very close together. Dorsal fins subequal, the first above or behind the pelvis, the second in advance of the anal, which is continuous at the base with the lower caudal lobe. Caudal of moderate length; axis not directed upwards; lower lobe notched posteriorly. Pectorals broad, with straight or convex edges and rounded angles.

Seven species from the Indo-Pacific.

## *Synopsis of the Species.*

I. Mouth nearer to the end of the snout than to the vertical from the eyes; origin of first dorsal behind the base of pelvis; dorsal fins with concave free edges.

A. A large ocellus above the pectoral fin.

Base of first dorsal  $\frac{2}{3}$  to  $\frac{3}{4}$  its distance from the second; body with scattered rounded dark spots

1. *ocellatum*.

Base of first dorsal  $\frac{1}{2}$  its distance from the second; body with numerous close-set dark spots

2. *trispeculare*.

B. No ocellus above the pectoral fin

3. *freycineti*.

II. Mouth nearer to the vertical from the eyes than to the end of the snout; fold of the lower lip continuous.

A. Origin of first dorsal above the anterior part of base of pelvis; dorsal fins with concave free edges

4. *punctatum*.

B. Origin of first dorsal above the posterior end of base of pelvis; dorsal fins with straight or convex free edges.

1. A single more or less distinct median dorsal keel.

Anal as deep as lower caudal lobe, its length  $\frac{2}{3}$  to  $\frac{3}{4}$  that of the latter in front of the notch; no white or pale spots

5. *griseum*.

Anal usually deeper than lower caudal lobe, its length from less than  $\frac{2}{3}$  to nearly  $\frac{3}{4}$  that of the latter in front of the notch; body with round or oval white or pale spots

6. *plagiosum*.

2. Three dorsal keels

7. *indicum*.

## 1. CHILOSCYLLIUM OCELLATUM.

*Squalus ocellatus* Gmelin, Linn. Syst. Nat. p. 1494 (1788);  
Schneid. Bloch's Syst. Ichth. p. 129 (1801).

*Hemiscyllium ocellatum* Müll. & Henle, Plagiost. p. 16 (1841);  
Duméril, Elasmobr. p. 326 (1865).

*Scyllium ocellatum* Blyth, Journ. As. Soc. Bengal, 1847, p. 726,  
pl. xxvi. fig. 2.

*Chiloscyllium ocellatum* Günth. Cat. Fish. viii. p. 410 (1870).

No dorsal keel, except between the dorsal fins. Mouth nearer to the end of snout than to the vertical from the eyes; fold of lower lip not continuous; nasal cirrus extending to edge of nasal valve. Nearly the whole of the spiracle below the eye. First dorsal originating well behind the base of pelvics; free edge of the fin concave; length of base  $\frac{2}{3}$  to  $\frac{3}{4}$  the distance from second dorsal. Origin of anal at a distance from the vertical from the end of base of second dorsal greater than the length of the latter; length of base of anal about  $\frac{2}{3}$  of that of lower caudal lobe in front of the notch. Pectoral extending  $\frac{3}{8}$  to  $\frac{3}{4}$  of the distance from its origin to that of the pelvics. Scattered round dark spots on the body; a large ocellus above the pectoral fin; indistinct cross-bars on the back; two large spots on the anterior edge of each dorsal fin.

New Guinea and Northern Australia to the Kermadec Islands.

1. (630 mm.).		
2. (590 mm.).	Cape York.	Herr Dämel.
3-4. (410 and 420 mm.)	Sunday Is.	J. B. Jukes, Esq.
5. (400 mm.).	Solomon Isds.	
6. (360 mm.)	N.W. Australia.	Haslar Coll.

## 2. CHILOSCYLLIUM TRISPECULARE.

*Hemiscyllium trispeculare* Richards. Ic. Pisc. p. 5, pl. i. fig. 2 (1843), and Erebus & Terror, Fish. p. 43, pl. xxviii. (1844).

*Chiloscyllium trispeculare* Günth. Cat. Fish. viii. p. 411 (1870).

Scarcely specifically distinct from *C. ocellatum*, but with somewhat larger fins and with a different coloration. Length of base of first dorsal  $\frac{4}{5}$  its distance from the second; pectoral extending  $\frac{4}{5}$  of the distance from its origin to that of the pelvics. Body densely covered with brownish spots, the larger of which are studded with several small darker spots; a large ocellus above the pectoral fin, followed by one or two smaller ones; indistinct cross-bars on the back; two large spots on the anterior edge of each dorsal fin.

North-west Australia.

1. (550 mm.) type of the species.	N.W. Australia.	Sir J. Richardson.
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## 3. CHILOSCYLLIUM FREYCINETI.

*Scyllium freycineti* Quoy & Gaim. Voy. Uran., Poiss. p. 192 (1824).

*Scyllium malaisianum* Less. Voy. Coquille, Zool. ii. p. 94, pl. vi. (1830); Günth. Cat. Fish. viii. p. 411 (1870).

*Chiloscyllium malaianum* Müll. & Henle, Plagiost. p. 20 (1841); Duméril, Elasmobr. p. 332 (1865).

Apparently closely allied to the two preceding species, but without the ocellus above the pectoral fin; spots on the body as in *C. ocellatum*, but more numerous; indistinct cross-bars on the back and spots on the dorsal fins as in the two preceding species.

Waigiou.

#### 4. CHILOSCYLLIUM PUNCTATUM.

*Chiloscyllium punctatum* Müll. & Henle, Plagiost. p. 18, pl. iii. (1841); Bleek. Verh. Bat. Gen. xxiv. 1852, Plagiost. p. 22; Duméril, Elasmobr. p. 330 (1865); Günth. Cat. Fish. viii. p. 413 (1870).

*Chiloscyllium griseum* Müll. & Henle, t. c. pl. iv.

No dorsal keel, except between the dorsal fins. Mouth much nearer to the vertical from the eyes than to the end of snout; fold of lower lip continuous; nasal cirrus extending well beyond the edge of nasal valve. Nearly the whole of the spiracle below the eye. First dorsal originating above the anterior part of base of pelvics; free edge of the fin concave; length of base not much less than the distance from second dorsal. Origin of anal at a distance from the vertical from the end of base of second dorsal equal to less than  $\frac{1}{2}$  the length of the latter; length of base of anal from a little more than  $\frac{2}{3}$  to nearly  $\frac{3}{4}$  of that of the lower caudal lobe in front of the notch. Pectoral extending  $\frac{3}{4}$  to  $\frac{7}{8}$  of the distance from its origin to that of the pelvics. Body with or without small dark spots; young with broad dark cross-bars, one across the head, one at the level of the pectorals, one just in front of and another at the posterior end of each of the dorsal fins, and three behind the second dorsal.

Malay Archipelago.

- |  |                           |                   |
|--|---------------------------|-------------------|
| 1. (640 mm.) ♀, uniformly greyish.                             | Thursday Is., Torres Str. | Earl of Crawford. |
| 2. (600 mm.) ♂, with scattered dark spots, without cross-bars. | Singapore.                | Fisheries Exhib.  |
| 3. (340 mm.) ♀, with cross-bars, without spots.                | Java.                     | Dr. P. Bleeker.   |

#### 5. CHILOSCYLLIUM GRISEUM. (Plate XI. fig. 1, and Plate XIII. fig. 1.)

*Chiloscyllium plagiosum*, var. 1, Müll. & Henle, Plagiost. p. 18 (1841).

*Chiloscyllium griseum* Müll. & Henle, t. c. p. 19.

*Chiloscyllium plagiosum* (part.) Cantor, Cat. Mal. Fish. p. 392 (1850).

*Chiloscyllium plagiosum* Bleek. Verh. Bat. Gen. xxiv. 1852, Plagiost. p. 17; Duméril, Elasmobr. p. 328 (1865); Day, Fish. Malabar, p. 267 (1865).

*Chiloscyllium indicum*, vars.  $\gamma$  and  $\zeta$  (part.) Günth. Cat. Fish. viii. p. 412 (1870).

*Chiloscyllium indicum* Day, Fish. India. p. 726, pl. clxxxviii. fig. 3 (1878).

A single more or less prominent dorsal keel. Mouth much nearer to the vertical from the eyes than to the end of snout; fold of the lower lip continuous; nasal cirrus extending to the edge of nasal valve or slightly beyond. Anterior part of spiracle below the posterior part of eye. First dorsal originating above the posterior end of base of pelvics; free edge of fin straight or convex; length of base from  $\frac{2}{3}$  to as long as the distance from second dorsal. Origin of anal at a distance from the vertical from end of base of second dorsal a little less than the length of the latter; anal as deep as lower caudal lobe.  $\frac{2}{3}$  to  $\frac{5}{8}$  the length of the latter in front of the notch. Pectoral extending  $\frac{3}{4}$  to  $\frac{7}{8}$  of the distance from its origin to that of the pelvics. Young with very distinct, broad, dark cross-bars, which become somewhat narrower on the sides and broaden out again and unite below, the lower surface being uniformly dark; interspaces between the bars in great part occupied by oblong or oval spots; bars about 12 in number, one across the snout, four more anterior to the first dorsal; one at the end of the base of each dorsal and one in front of the second dorsal; three or four behind the second dorsal. Half-grown examples with bars less distinct and not united below, sometimes edged with darker lines or series of spots; interspaces and lower surface uniformly pale. Adults uniformly greyish or brownish.

Coasts of India to the Malay Archipelago.

I. Adults, without cross-bars.

- |   |            |                      |
|---|------------|----------------------|
| 1. (580 mm.) ♂, type of <i>C. hasseltii</i> . | Moluccas.  | Dr. P. Bleeker.      |
| 2. (550 mm.) ♀.                               | Kurrachee. | F. W. Townsend, Esq. |
| 3. (460 mm.) ♂, <i>C. obscurum</i> Gray.      | Moluccas.  |                      |

II. Half-grown specimens, with more or less distinct cross-bars.

A. Cross-bars without darker edges.

- |                    |              |                 |
|--------------------|--------------|-----------------|
| 1-3. (140-245 mm.) | Vizagapatam. | Capt. Mitchell. |
| 4-6. (120-340 mm.) | Madras.      | F. Day, Esq.    |
| 7-9. (120-270 mm.) | Malabar.     | F. Day, Esq.    |

B. Cross-bars edged with darker lines or series of spots.

- |                        |         |             |
|------------------------|---------|-------------|
| 1. (245 mm.)           | Pinang. | Dr. Cantor. |
| 2-3. (170 and 190 mm.) |         |             |

III. Young, with cross-bars very conspicuous and united below.

- |              |                  |            |
|--------------|------------------|------------|
| 1. (122 mm.) | Malay Peninsula. | Mr. Evans. |
|--------------|------------------|------------|

Müller and Henle's typical specimen, from Malabar, evidently belongs to this species. The discrepancies which they observe between their specimens and the figure which they reproduce is due, not to the inaccuracy of the latter, as they supposed, but to its representing another species, viz. *C. punctatum*.

## 6. CHILOSCYLLIUM PLAGIOSUM. (Plate XII. fig. 1.)

*Scyllium plagiosum* Bennett, in Life of Raffles, p. 694 (1830).

*Scyllium ornatum* Gray, Ill. Ind. Zool. i. pl. xcviii. fig. 2 (1832).

*Chiloscyllium plagiosum*, vars. 2, 3 and 4, Müll. & Henle, Plagiost. p. 18 (1841).

*Chiloscyllium plagiosum* (part.) Cantor, Cat. Mal. Fish. p. 392 (1850).

*Chiloscyllium margaritiferum* Bleek. Ned. Tijds. Dierk. i. 1863, p. 243; Duméril, Elasmobr. p. 329 (1865).

*Chiloscyllium indicum*, vars.  $\alpha$  and  $\beta$ , Günth. Cat. Fish. viii. p. 412 (1870).

*Chiloscyllium indicum* Jord. & Fowler, Proc. U.S. Nat. Mus. xxvi. 1903, p. 605, fig. 2.

Very closely allied to *C. griseum*, but with quite a different coloration. Dorsal fins usually shorter and more elevated, the length of the base of the first  $\frac{2}{3}$  to  $\frac{4}{5}$  its distance from the second. Anal usually shorter and deeper, its depth usually distinctly greater than that of the lower caudal lobe, its length from less than  $\frac{2}{5}$  to nearly  $\frac{3}{4}$  that of the latter in front of the notch. Dark cross-bars arranged as in *C. griseum*, but much narrower and persistent in the adult; edges of the bars crenate; numerous round or oval white spots on the cross-bars and at their edges, as well as on the lower parts of the body; dark spots either few, large, and definitely arranged in the mid-dorsal line and at the edges of the bars, or small, numerous, and irregularly arranged on head, body, and fins.

Coasts of China and Japan to the Malay Peninsula and Archipelago.

1, 2-5, 6-7. (650 mm., 370-540 mm., 125 and 245 mm.)	Japan.	
8. (580 mm.)	Formosa.	R. Swinhoe, Esq.
9. (450 mm.)	Singapore.	Fisheries Exhib.
10. (250 mm.)	Manado.	Dr. B. Meyer.
11. (220 mm.)	Amoy.	
12. (170 mm.)	Manilla.	'Challenger.'
13. (150 mm.)	China.	J. R. Reeves, Esq.

## 7. CHILOSCYLLIUM INDICUM. (Plate XIII. fig. 2.)

*Squalus indicus* Gmelin, Linn. Syst. Nat. p. 1503 (1788); Schneid. Bloch's Syst. Ichth. p. 137 (1801).

*Squalus tuberculatus* Schneid. l. c.

*Chiloscyllium tuberculatum* Müll. & Henle, Plagiost. p. 19 (1841); Bleek. Verh. Bat. Gen. xxiv. 1852, Plagiost. p. 17; Duméril, Elasmobr. p. 331 (1865); Kner, 'Novara' Fische, p. 412 (1865).

*Squalus caudatus* Gronov. Syst. p. 8 (1854).

*Chiloscyllium phymatodes* Bleek. t. c. p. 21; Duméril, l. c.

*Synchismus tuberculatus* Gill, Ann. Lyc. N. York, 1861, p. 408.

*Chiloscyllium indicum*, vars.  $\delta$ ,  $\epsilon$ , and  $\zeta$  (part.), Günth. Cat. Fish. viii. p. 412 (1870).

Three prominent dorsal keels. Mouth much nearer to the

vertical from the eyes than to the end of snout; fold of lower lip continuous; nasal cirrus extending to the edge of nasal valve. Anterior edge of spiracle vertically below the posterior edge of eye. First dorsal originating above the posterior end of base of pelvics; free edge of the fin straight or convex; length of base  $\frac{1}{2}$  to  $\frac{2}{3}$  the distance from second dorsal. Origin of anal at a distance from the vertical from end of base of second dorsal considerably greater than the length of the latter; length of base of anal equal to or a little greater than that of the lower caudal lobe in front of the notch. Pectoral extending about  $\frac{2}{3}$  of the distance from its origin to that of the pelvics. Head and body with dark reddish spots or vermiculations, some of which may unite to form pairs of transverse stripes.

From the Cape of Good Hope to China.

- |   |                    |                    |
|---|--------------------|--------------------|
| 1. (275 mm.) skin, type of the species*.    |                    | Gronow Coll.       |
| 2. (270 mm.) type of <i>C. phymatodes</i> . | Java.              | Dr. P. Bleeker.    |
| 3. (380 mm.)                                | China.             | Sir J. Richardson. |
| 4, 5. (250 and 290 mm.)                     |                    |                    |
| 6. (430 mm.) stuffed.                       | Cape of Good Hope. | Sir A. Smith.      |

#### 8. STEGOSTOMA.

*Stegostoma*, Müll. & Henle, Arch. f. Naturgesch. 1837, i. p. 395, and Plagiost. p. 24 (1841); Günth. Cat. Fish. viii. p. 409 (1870).

Head obtuse; body elongate, compressed posteriorly. Mouth transverse; teeth small, tricuspid, in many series, occupying in each jaw a flat, four-sided area; lower lip not divided by a symphysial groove. Nasal valves separate, each with a cirrus. Eye small; no longitudinal fold below the eye. Spiracles moderately large, nearly vertical, behind the eyes. Gill-openings of moderate width, last three above the base of the pectoral; last two very close together. First dorsal partly above and partly in advance of the pelvics, somewhat larger than the second, which is partly above and partly in advance of the anal, which terminates immediately in front of the caudal. Caudal very long; axis not directed upwards; lower lobe notched posteriorly. Pectorals broad, with straight or notched edges and rounded angles.

A single species from the Indo-Pacific.

#### STEGOSTOMA TIGRINUM.

*Squalus tigrinus* Gmelin, Linn. Syst. Nat. p. 1493 (1788); Forst. Zool. Ind. p. 24, pl. xiii. fig. 2 (1795).

*Squalus longicaudus* Gmelin, t.c. p. 1496.

\* I am unable to understand Dr. Günther's statement that the anal fin is cut away in this specimen. It is true the species was described by Gronow as lacking an anal fin, but this was because he made the very natural mistake of regarding the anal fin as part of the caudal, as is evident from his description:—"Lobis qui subtus caudam occupant bini lineares, longi, aequales, convexi."

*Squalus fasciatus* Bloch, Ausl. Fische, pl. cxiii. (1795);  
Schneid. Bloch's Syst. Ichth. p. 130 (1801).

*Scyllium heptagonum* Rüpp. Neue Wirbelth., Fische, p. 61,  
pl. xvii. fig. 1 (1840).

*Stegostoma fasciatum* Müll. & Henle, Plagiost. p. 25, pl. xvii.  
(1841); Cantor, Cat. Mal. Fish. p. 396 (1850); Bleek. Verh. Bat.  
Gen. xxiv. 1852, Plagiost. p. 23; Duméril, Elasmobr. p. 336  
(1865); Günth. & Playfair, Fish. Zanzibar, p. 140 (1866); Klunz.  
Fische Roth. Meer. p. 672 (1870).

*Stegostoma carinatum* Blyth, Journ. As. Soc. Bengal, xvi.  
1847, p. 725, pl. xxv. b, fig. 1.

*Squalus cirrosus* Gronov. Syst. p. 6 (1854).

*Stegostoma tigrinum* Günth. Cat. Fish. viii. p. 409 (1870);  
Day, Fish. India, p. 725, pl. clxxxvii. fig. 4 (1878).

Three dorsal keels, as in *Chiloscyllium indicum*, more prominent  
in the adult than in the young; adults also with a pair of lateral  
keels. Mouth a little nearer to the vertical from the eyes than  
to the end of snout; fold of lower lip broadly interrupted; nasal  
cirrus extending to the edge of nasal valve. First dorsal rather  
elongate, gradually increasing in height posteriorly and ter-  
minating above the end of base of pelvics; free edge convex,  
angles rounded; second dorsal originating directly behind the  
first, terminating above the middle of anal. Caudal as long as  
the rest of the fish. Pectoral nearly reaching the origin of  
pelvics. Young with broad dark brown cross-bars with blackish  
margins, wider than the pale yellowish interspaces; during  
growth the bars become paler and dark spots appear on them,  
whilst the dark edges of the bars break up into spots; adults  
without bars, with numerous vertical series of dark rounded  
spots.

Indian Ocean; East Indian Archipelago; China.

1-2. (1120 and 750 mm.)	Zanzibar.	Lieut.-Col. Playfair.
3-4. (650 and 420 mm.)	Formosa.	R. Swinhoe, Esq.
5. (300 mm.)	Rejang R., Sarawak.	B. Low, Esq.
6. (200 mm.)	N.W. Australia.	Capt. D. Le Sauvage.

In addition to the specimens listed above, on which my de-  
scription is based, there are some large stuffed examples from  
India (*Jerdon*), Ceylon (*Zool. Soc.*), and Zanzibar (*Playfair*).

#### EXPLANATION OF THE PLATES.

##### PLATE XI.

- Fig. 1. *Chiloscyllium griseum*.  
2. *Orectolobus ornatus*; 2a, head seen from below.

##### PLATE XII.

- Fig. 1. *Chiloscyllium plagiosum*.  
2. *Orectolobus tentaculatus*; 2a, head seen from below.

##### PLATE XIII.

- Fig. 1. *Chiloscyllium griseum*.  
2. *C. indicum*; 2a, head seen from above; 2b, from below.

2. A Note on the Occurrence of a Species of *Phreatothrix* (Vejdovsky) in England, and on some Points in its Structure. By FRANK E. BEDDARD, M.A., F.R.S., F.Z.S., Korresp. Mitgl. d. K. Böhm. Ges. Wiss., &c.

[Received April 28, 1908.]

(Text-figures 76 & 77.)

A few days since Dr. Harmer, F.R.S., was so good as to forward to me a number of worms which had been sent to the Cambridge Museum for identification under the following circumstances:—A gentleman resident near Cambridge has bored a well upon his property, and in the water drawn from this well appeared considerable numbers of an Oligochæte which proves to belong to the genus described some thirty years since by Prof. Vejdovsky, C.M.Z.S.\*, from examples supplied to him from a well in Prague. So far as I am aware, that memoir is the only one of recent date which contains any information upon this worm, which appears, however, to have been originally described about one hundred years earlier from the same city. It is clearly therefore a genus which is limited to underground waters; and I am not aware of any other record of its occurrence save those referred to, and that to be communicated in the present report to the Zoological Society of London.

I am therefore able to record the presence of this interesting Lumbriculid in this country for the first time.

The account given of it by Vejdovsky† seems to me, after having carefully examined a number of examples of the living worm, to have included all the chief points in its structure. There remain some minutiae in which I differ from Vejdovsky or supplement him. The differences are, I am inclined to think, due to a difference between the species.

In his account of the species given in his great work upon the Oligochæta‡, Vejdovsky figures the minute tactile processes which stand stiffly out from the prostomium. I find that these processes are not limited to the prostomium—though doubtless more numerous there than elsewhere,—but occur also even on the seta-bearing segments for some distance back. As I shall bring forward in the sequel some reasons for regarding this species as being hitherto undescribed, this point may be possibly urged as among those which prove this view.

The setæ do not appear in their general arrangement or form to differ from those of *Phreatothrix pragensis*. But in one of the examples which I studied (text-fig. 76) I found a persistence of setæ on the first segment, which is at least extremely unusual among the

\* Zeitschr. wiss. Zool. Bd. xxvii. p. 543 (1876), with preliminary notes in earlier papers quoted by him.

† Zeitschr. wiss. Zool. Bd. xxvii. p. 548.

‡ Syst. u. Morph. d. Oligochæten, Prag, 1884, p. 54.



Oligochaeta. On the first segment of one specimen the ventral setae were evident on both sides of the body, but showed an inequality of development. On the right side there were two setae, but both of them immature, the immaturity being unequal. One of the setae was like the "Soies de remplacement" of other segments. It was complete down to the node. The other seta was merely a slender short rod of chitin. On the left side of the body I only found one rudimentary seta, which was like the least developed seta of the right side and merely a short slender rod exactly of the same form and size.

Text-fig. 76.

*Phreatothrix cantabrigiensis.*

Ventral pair of setae of segment I.

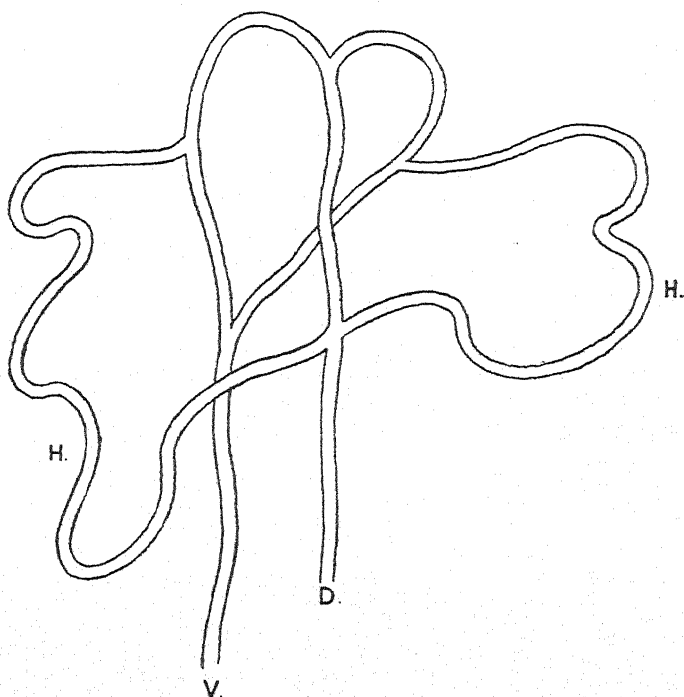
The *vascular system* seems to present certain recognisable differences from that of *Phreatothrix pragensis* described by Vejdovsky, and it is really mainly by reason of this that I venture to create a new species for this *Phreatothrix* from Cambridge. Vejdovsky has figured\* the way in which the dorsal vessel ends anteriorly. It appears to bifurcate in the fourth segment and to give off anteriorly to this point three pairs of lateral vessels which join the ventral vessel.

I found in an example, studied with a special view of elucidating the mode of bifurcation of the dorsal vessel, a different arrangement anteriorly. The dorsal vessel (text-fig. 77) divided quite at the anterior end of the body, and the first pair of transverse vessels uniting it with the ventral vessel arose from it some way behind this point of bifurcation. On the other hand, these two lateral vessels joined each half of the ventral vessel formed by the splitting of the dorsal vessel some way before the latter united to form the single ventral blood-vessel. This very considerable difference appears to me to be quite of specific value, and there is hardly room for an error so very considerable, either on my part or on that of the Bohemian Professor.

\* Zeitschr. wiss. Zool. t. c. Taf. xxxix. fig. 2.

There is another important point in the structure of the vascular system in which I find that my species does not agree with *Phreatothrix pragensis*. It is characteristic of the latter, as of some other Lumbriculids, that the dorsal vessel in the intestinal region gives off a series of blindly ending transverse appendages, which are contractile. Such structures demand the living worm for their successful demonstration. I examined several specimens with great care in order to ascertain if these characteristic cæcal vascular trunks were to be seen; and I utterly failed to see them.

Text-fig. 77.

*Phreatothrix cantabrigiensis*.

Anterior end of dorsal and ventral vascular trunks.

D. Dorsal vessel. | H. "Hearts." | V. Ventral vessel.

I cannot think that they were present in the greater part of the intestinal tract, where I sought them in vain. I have the more confidence in my ability to see these contractile appendages in that I recognised the network of non-contractile vessels upon the gut, which Vejdovsky does not record in *Phreatothrix pragensis*. These vessels formed a close lattice-work upon the gut, quite

similar to that which has been described, for instance, by Štolc in *Lophochaeta*\*, whose excellent figure of the same has been reproduced by myself in my 'Monograph of the Oligochaeta'†. This system of capillaries was only to be clearly seen during the diastole of the dorsal blood-vessel.

In certain other minutiae of structure the present examples also do not agree with the species *P. pragensis*; for instance, I found in several examples of my species that the investment of chloragogen cells of the alimentary tract commences in segment viii.

Vejdovsky mentions segment xii. as being that in which this investment is first visible in *Phreatothrix pragensis*. Vejdovsky has mentioned that in the living worm the mouth-aperture is seen to be covered with ciliated cells, the cilia being in active motion. It appeared to me that this ciliation in my species extended also on to the prostomium, but certainly not far on to that part of the body. It was in any case very clearly visible in the mouth and just at its outside. This state of affairs was, however, quite unrecognisable in one of the two specimens in which I particularly studied it. It is not very easy to miss actively vibratile cilia in this position, so that I am confident in my assertion that there was no active ciliation in one specimen. Whether this is a variable character in the species or was due to temporary cessation of movement‡ I am unable to say.

The *nephridia* of *Phreatothrix* are in some ways remarkable. Vejdovsky has pointed out that a single pair may occupy a number of segments. I found precisely the same extension of the nephridia through several segments in the examples which I have studied. There is, however, some difference in the earlier account given by Vejdovsky from the later account of the nephridia of *Phreatothrix pragensis* which is important, in view of the facts which I have noted in the position of the nephridia of my own species of *Phreatothrix*. In the earlier paper on the species (that in the 'Zeitschrift für wissenschaftliche Zoologie') he figures § two pairs of nephridia, a pair in each of segments vii. and viii., each pair only occupying its own segment, though the funnel of course lies in the segment in front. In the 'System und Morphologie der Oligochaeten' || he figures a pair which open, indeed, on to the viii. segment, but which extend back as far as the xiv. These are followed by another pair which open on to the xiv. segment, but which extend back as far as the xx. Both individuals figured are represented as sexually mature. It may be that Vejdovsky had before him examples, not only of *Phreatothrix pragensis* but also of the species with which I deal here, and which I believe to be distinct from that.

I have myself found a nephridium on each side in segment vii.;

\* Abhandl. Böhm. Ges. Wiss. (2) vii. (1889).

† Oxford, 1895, p. 241, fig. 41.

‡ I kept the specimen under intermittent observation for most of a morning, and supplied fresh water at times.

§ *Tom. cit.* pl. xxxix. fig. 2.

|| Pl. xi. fig. 18.

apparently these nephridia are confined to that segment, with the exception, of course, of the funnels. In the following segment, viz., viii., there was another pair of rather smaller excretory glands. A third pair of the same size, or nearly so, were to be found in segment ix. Then followed a gap and the next pair were in segment xv., extending, however, through the two following segments as well—that is to say, three in all, exclusive of the segment which contains the funnel. Further back still a pair of nephridia extended through four segments which I have not mapped accurately. It is clear that in any case this species shows some differences from both accounts given by Vejdvosky. But the facts are not irreconcilable with his earlier account, which, as I have suggested, may refer to the same species which I consider here, or may merely lend evidence to the view that the species varies in the number and position of its nephridia.

The *generative organs* appear to be like those of *Phreatothrix pragensis*, save in one respect. I have, however, examined only a single sexually mature individual. In *Phreatothrix pragensis* there is a second pair of spermathecæ in segment xii. rather smaller than those of segment xi. I looked carefully for, but was unable in my species to find, the second pair. I noted the sperm-sacs to lie in segments xi., xii., and xiii. The spermathecæ and atria open behind the ventral pair of setæ, which are present and have not disappeared. This is quite in accord with Vejdvosky's statements concerning *Phreatothrix pragensis*.

To resume: this species from Cambridge appears to differ from that described by Vejdvosky from Prague in the following points, viz.:—(1) The chloragogen investment of the gut begins in segment vii.; (2) the dorsal and ventral vessels divide to reunite much further forward in the body; (3) there are no contractile appendages of the dorsal vessel; (4) the number and arrangement of the nephridia is somewhat different; (5) the spermathecæ of segment xii. have totally disappeared.

It seems to me that we have here a considerable number of differences which warrant the erection of a new species for the worms from Cambridge, which I propose to term *Phreatothrix cantabrigiensis*, or, in accordance with Michaelsen's views\*, *Trichodrilus cantabrigiensis*. Possibly this second species with nephridia extending through a considerable number of segments may be regarded as furnishing an argument for reinstating the genus *Phreatothrix*. On the other hand, inasmuch as this character is to be found in *Stylodrilus*† *vejdvoskyi*—a species belonging to a genus where there are no contractile appendages to the dorsal vessel,—the question of the generic distinctness of other Lumbriculids is perhaps raised by the facts which I am here able to bring to the notice of the Society.

\* Oligochæta in 'Das Tierreich,' Berlin, Oct. 1900, p. 58.

† Benham, Quart. Journ. Micr. Sci. vol. xxxiii. 1891, p. 42.

3. On the Amphipod Genus *Trischizostoma*.

By E. W. SEXTON.

[Received March 14, 1908.]

(Plates XIV.-XXI.)\*

During the cruise of the 'Huxley' in the Bay of Biscay, August 1906, a small collection of Amphipoda was taken, which was handed to me by Dr. Allen for examination.

Amongst them was a large female specimen of *Trischizostoma niceense*. On looking into the literature of the group there appeared to be so much confusion with regard to the two genera *Guerina* and *Trischizostoma*, that a thorough revision has been necessary.

To those who so kindly assisted me in this, my best thanks are due: to Prof. G. O. Sars for his gift of a co-type of *T. raschii*; to Dott. A. Della Valle for sending me his series of preparations of *Guerina niceensis*; to the Rev. T. R. R. Stebbing for permitting me to see his (as yet unpublished) manuscript on the S. African Lysianassidae, containing the description of a new species of *Trischizostoma*†; to Mons. E. Chevreux for his information concerning his specimen of *Guerinella niceensis*; to Dott. A. Brian for his paper on a specimen from the Gulf of Genoa; to Mr. W. M. Tattersall for his kindness in forwarding all his specimens to me as soon as he heard I was engaged on this paper; and to Dr. Calman for much assistance and for revising the manuscript.

## I. HISTORICAL.

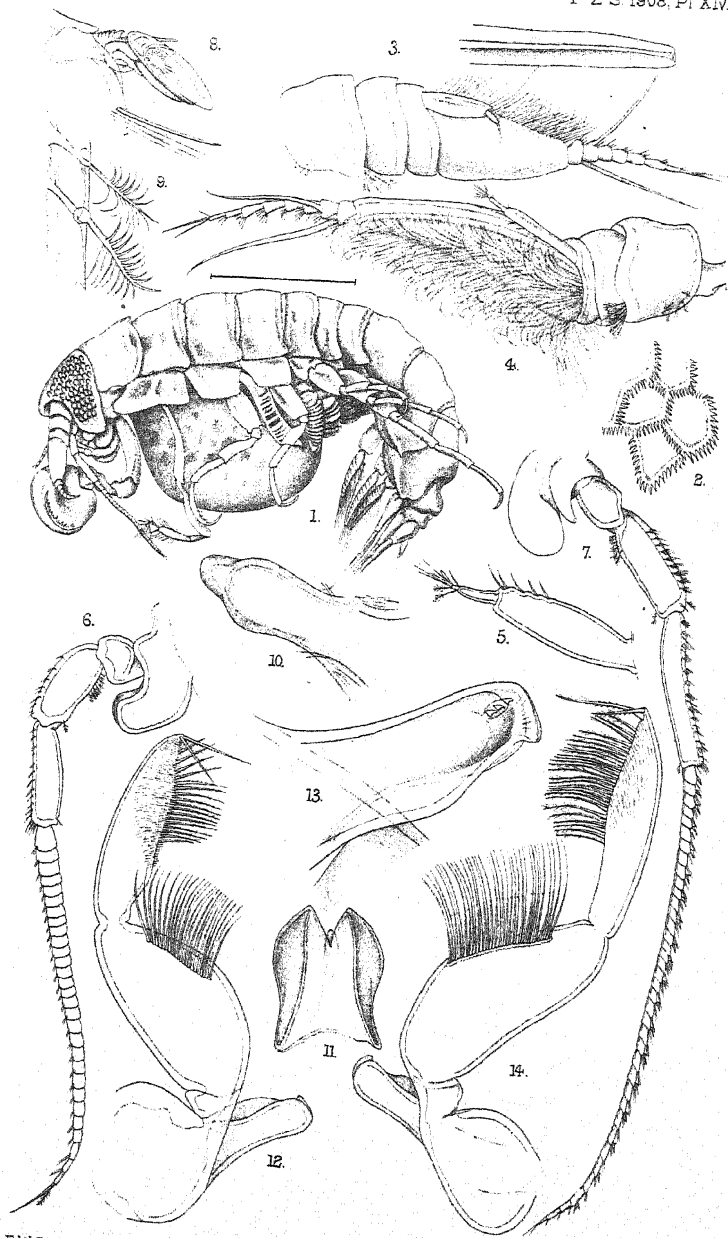
The first specimens of this genus were taken at Nice by the Rev. F. W. Hope and sent by him to the Director of the Naples Museum, Dott. Achille Costa, to be described and added to the list of Crustacea then being prepared for publication in the 'Fauna del Regno di Napoli' (2).

The description was written by Costa in 1853, a new genus *Guerinia*, Hope, being formed, and the type species, *Guerinia niceensis* figured, and was published at once with an account of two other crustaceans, under the title of "Tre nuovi Crostacei scoperti dal Rev. Gugl. F. Hope" (1). The description was published again, later in the same year, in the 'Fauna,' but the plate, although alluded to as plate vii. in the text, was omitted.

Costa recorded the specimens as parasitic on various fish, "sopra uno squalo e sul merluzzo ordinario," to which they were clinging

\* For explanation of the Plates, see p. 400.

† Since this paper was sent to press, Mr. Stebbing's article, cited below (20), containing the description of this new species, *Trischizostoma remipes*, has been published in the 'Annals of the South African Museum,' vol. vi. pt. 1: South African Crustacea, pt. 4, by the Rev. T. R. R. Stebbing, M.A., F.R.S., F.L.S., F.Z.S. With 14 plates. Cape Town: April 2, 1908. Pp. 59-64, pl. xxxiv.



E.W. Sexton del.  
M.P. Parker lith.

TRISCHIZOSTOMA NICAENSE, Costa.

Parker & West (imp.)



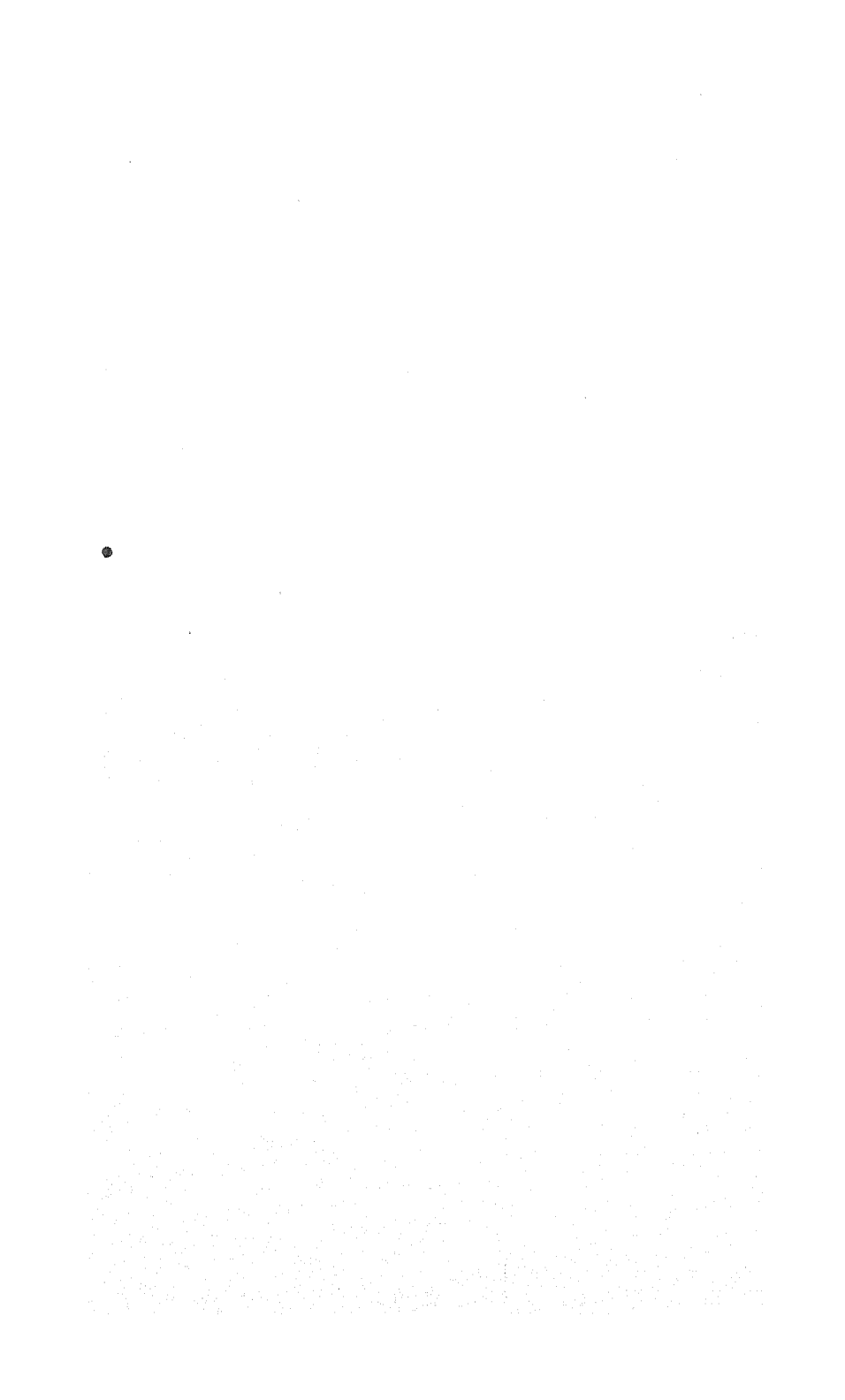


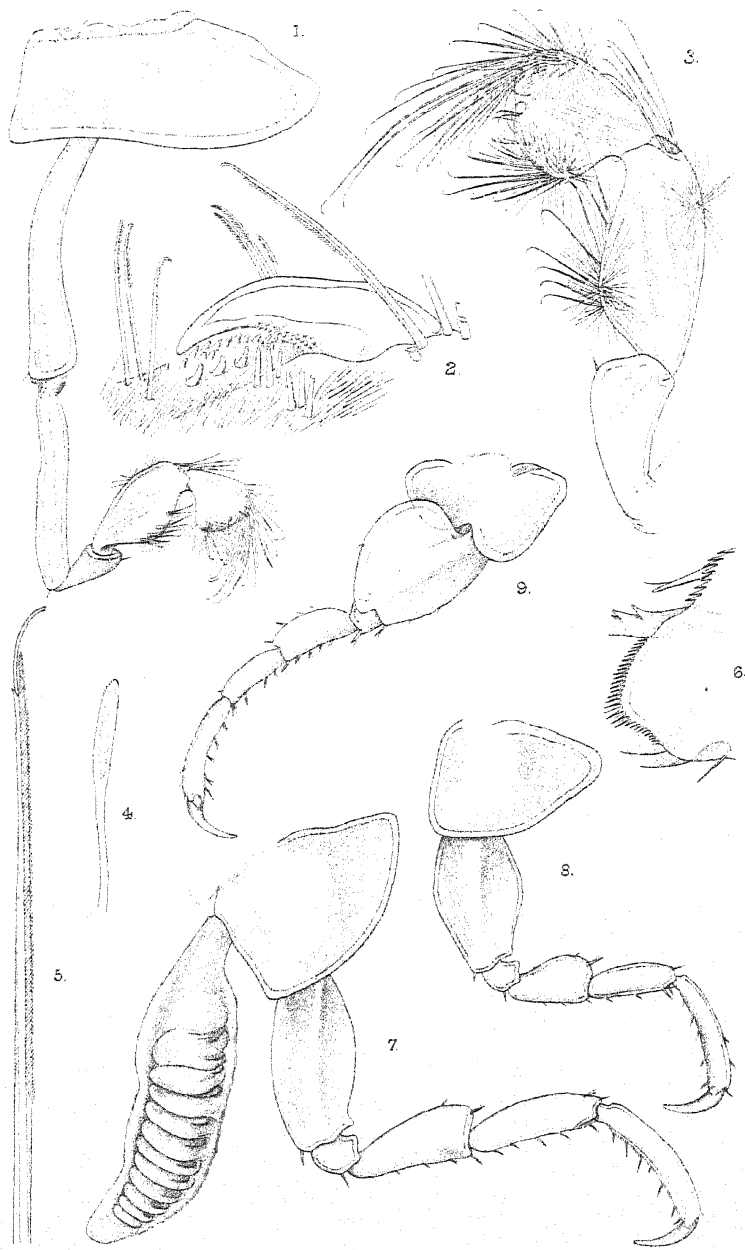
E.W.Sexton del.  
M.P.Parker lith.

Parker & West imp.

TRISCHIZOSTOMA NICAENSE, Costa.





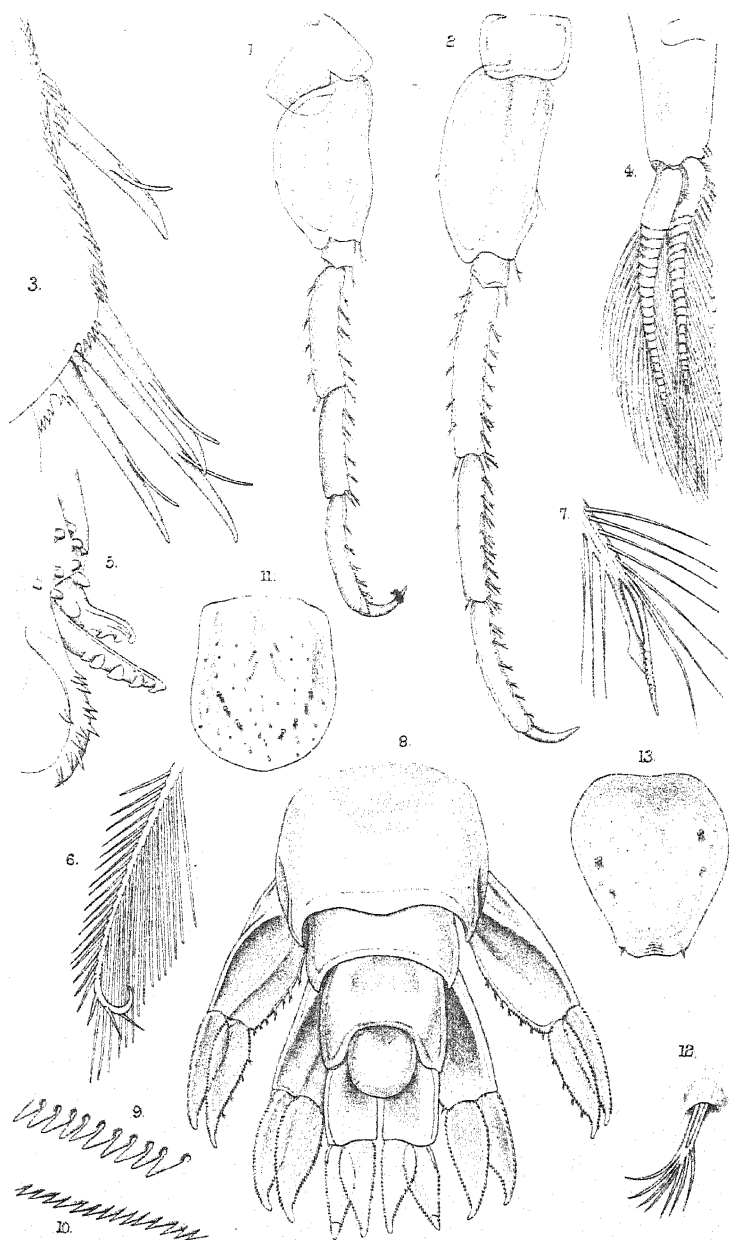


E.W. Sexton del.  
M.P. Parker lith.

Parker & West imp.

TRISCHIZOSTOMA NICÆENSE, Costa.





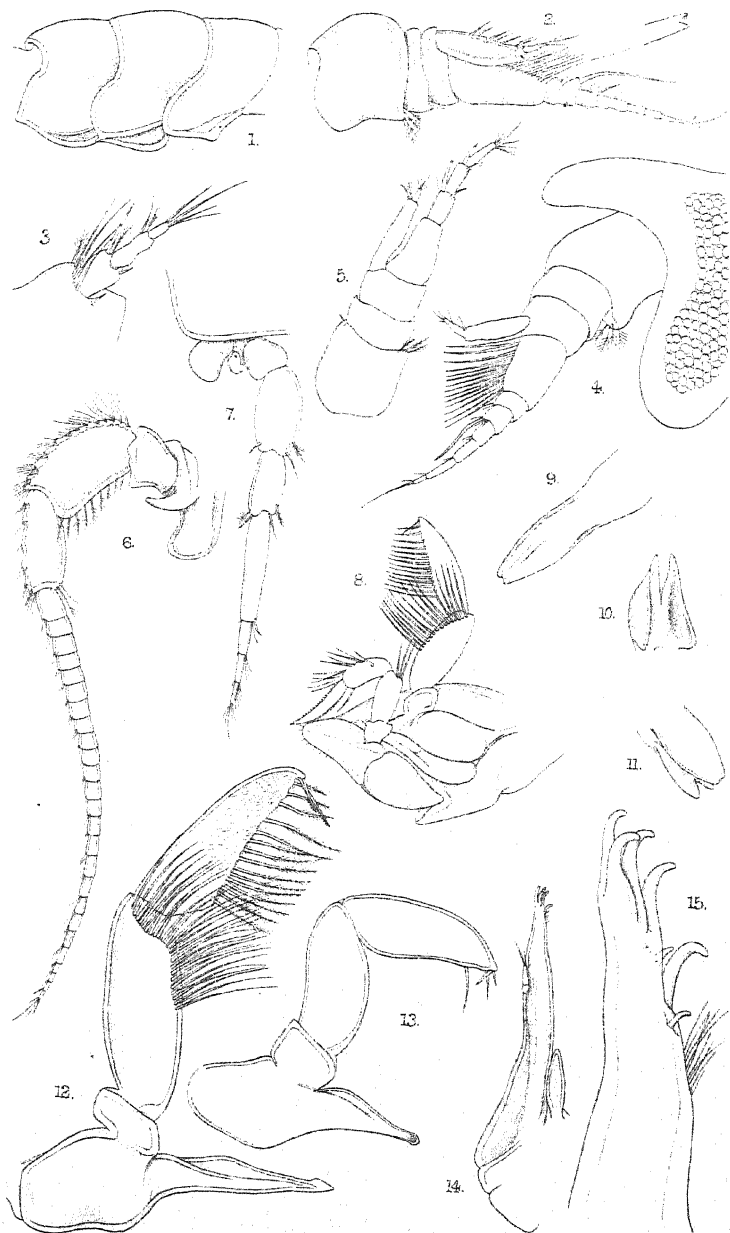
E.W. Sexton del.  
M.P. Parker lith.

Parker & West imp.

TRISCHIZOSTOMA NICÆENSE, Costa, figs. 1-12.

TRISCHIZOSTOMA HASCHII, Esmark & Boeck, fig. 13.



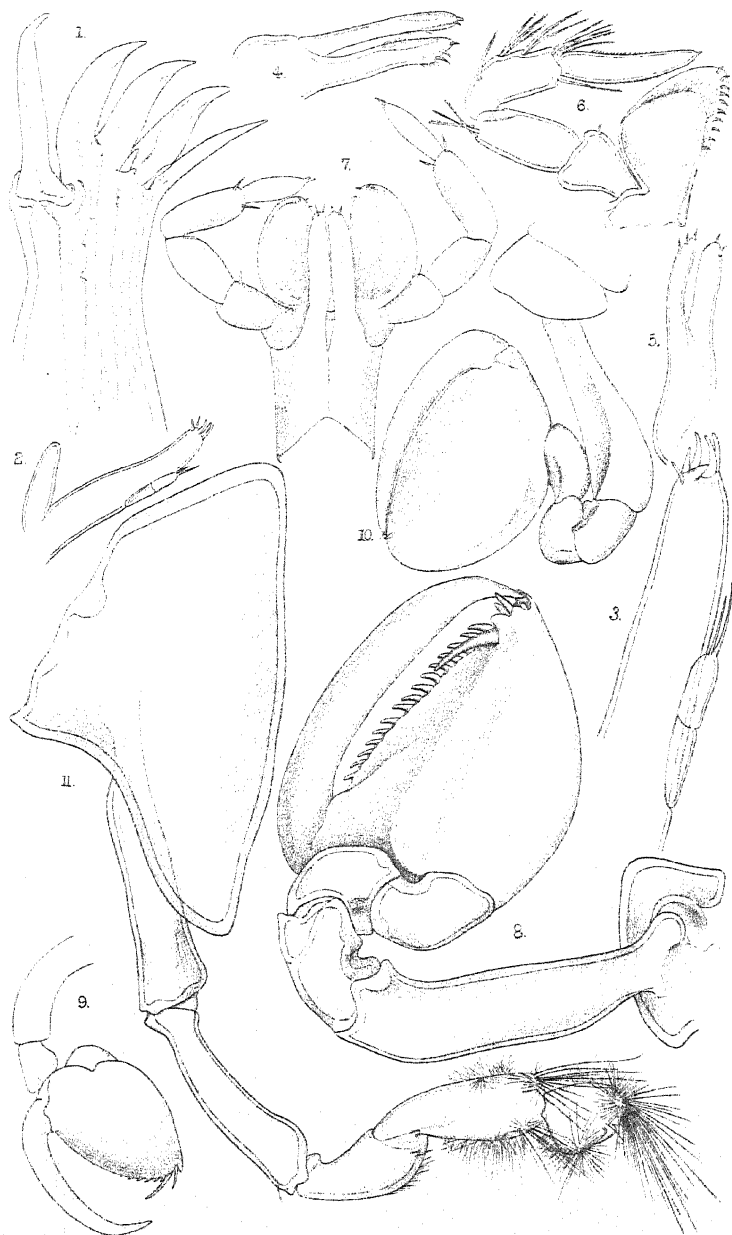


E.W. Sexton del.  
M.P. Parker lith.

TRISCHIZOSTOMA RASCHII, Esmark & Boeck.

Parker & West imp.





E. W. Sexton del.  
M. F. Parker lith.

Parker & West imp.

TRISCHIZOSTOMA RASCHII, Esmark & Boeck, figs. 2-11.

TRISCHIZOSTOMA NICAENSE, Costa, fig. 1.





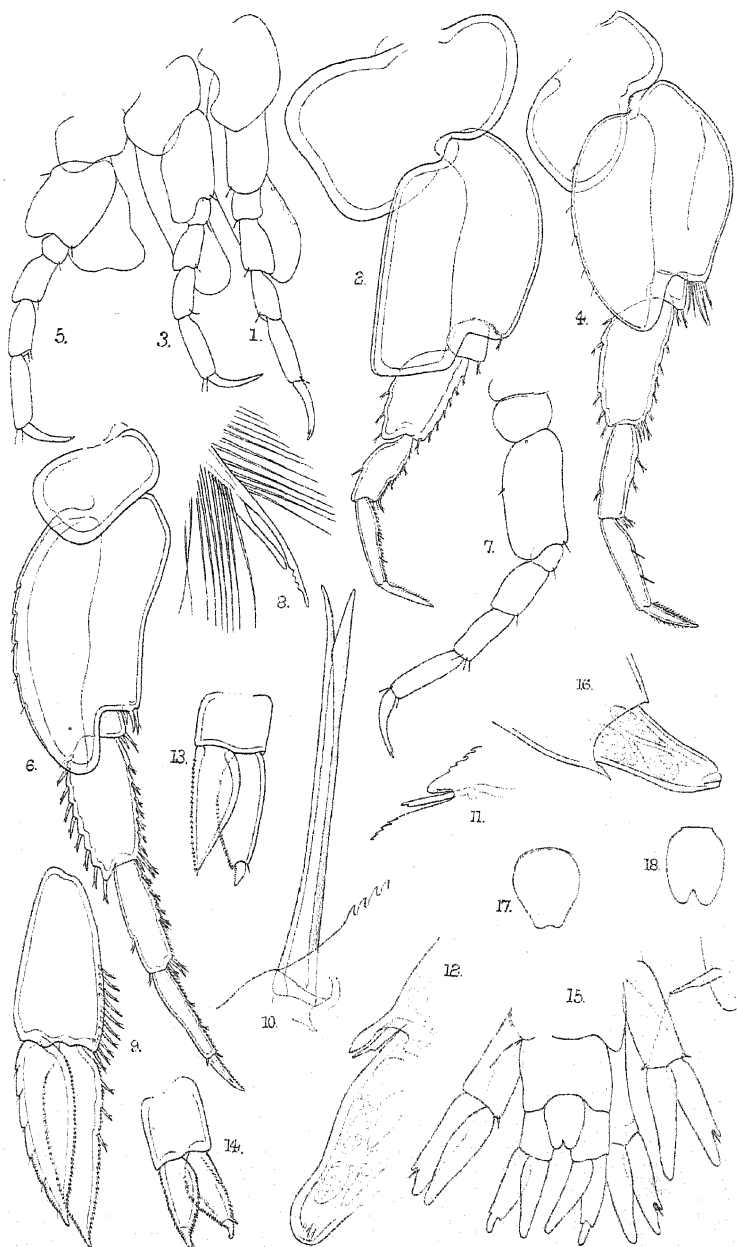


EW. Sexton del.  
M. P. Parker lith.

Parker & West imp.

TRISCHIZOSTOMA RASCHII, Esmark & Boeck.





E.W. Sexton del.  
M.P. Parker lith

Parker & West imp.

*TRISCHIZOSTOMA* RASCHII, Esmark & Boeck, figs 1-13; 15-18.

*TRISCHIZOSTOMA* NICAENSE, Costa, fig. 14.



by the strong claws of the first gnathopods. The figure given is that of a female, 25 mm. in length.

In 1860, Axel Boeck published his 'Observations on the Norwegian Amphipoda' (3). In this work he added a new tribe to the three already established primary divisions of the Amphipoda.

This tribe, *Prostomate*, was created for the reception of a "new and remarkable form," *Trischizostoma*, which Boeck regarded as a transition between the Hyperidæ and Gammaridæ, resembling the former in the structure of the head, the eyes, the antennæ, and the abdomen, and having much in common with the Gammaridæ, especially with the family Orchestidæ, and the genera *Opis* and *Anonyx*.

The *Prostomate* contain only the one genus *Trischizostoma* (so named by Esmark, who first distinguished it, from the trifid tube formed by its mouth organs) with the type species *T. raschii*, in describing which Boeck specially notes the peculiar structure of the first gnathopods.

The specimens described by Boeck, three large females, were dredged by Prof. Rasch at "Havbroen," a bank 20 miles off the west coast of Norway, in 100 fathoms.

In 1862, Spence Bate in his British Museum Catalogue (4) described and figured *Guerinia nicaensis*, placing the genus *Guerinia* in the subfamily *Phoxides* of the Gammaridæ, between the genera *Lafystius* and *Lepidactylis*. He adds, "For the description of this animal I am dependent upon the accuracy of the Rev. Mr. Hope's figure in the pamphlet quoted (Three New Crustacea, Fauna of Naples)"; but both the description and the figures, though evidently copied from Costa's, are inaccurate and misleading. For instance, in describing the second gnathopod, Costa states that it has one joint less than the normal number, being "entirely without a nail," and further, that "the fifth and last (article), which represents the hand, is the shortest of all, compressed, narrow at the base, dilated inferiorly, where it is fringed with stiff hairs which increase in length towards the anterior angle, the longest being twice the length of the hand"\*. Spence Bate gives the normal number of joints, applying Costa's description of the hand (propodos) to the nail (dactylos) thus— "propodos very small: *dactylos* triangular, dilated, compressed, flattened at the apex, fringed with long hairs." In order to bring the figure into agreement with his description he has emphasised the line by which Costa indicated the articulation of the last joint, so making it appear as another very small joint and calling it the "propodos."

In 1865, Lilljeborg (5) published two papers on the Lysianassina, the "*Lysianassa magellanica* etc." in English, and the "Bidrag till Kännedomen" in Swedish. They contain practically the same

\* "Il quinto ed ultimo (articolo) che rappresenta la mano è il più corto di tutti, compresso, stretto alla base, dilatato inferiormente, ove è ornato di peli rigidi e crescenti in lunghezza verso l'angolo anteriore, i maggiori essendo lunghi il doppio della lunghezza della mano."

matter. In the table given of the Gammaridæ, he brackets together as closely related "Subfamilia 4. *Phoxina* (Phoxides, Spence Bate), and Subfamilia 5. *Trischizostomatina* (Prostomatæ A. Boeck)"—"partes oris appendiculares non tubiformes" in *Phoxina*, and "tubiformes" in *Trischizostomatina*.

In 1867, Costa again refers to *Guerinia* in the catalogue of the Crustacea sent to the Paris Exposition (6) and gives the plate promised but not included in the 'Fauna di Napoli.'

In 1870 Boeck published his 'Crustacea Amphipoda Borealia' (7), a synopsis of the larger treatise then being prepared for the press. In this work he alters his previous classification of the group, the former tribe *Prostomatæ* being reduced to a family of the Gammaridæ. The diagnoses here given of the family *Prostomatidæ* with its one genus *Trischizostoma* and one species *T. raschii* are repeated in the later work, 'De Skandinaviske og Arktiske Amphipoder' (8), where Boeck again emphasises the resemblance to the Hyperina, and to the *Orchestidæ* and *Lysianassinæ* among the Gammarina.

Boeck records the capture of several specimens, all females, by Storm, in the Throndhjemsfjord, "parasite on a shark"—length from rostrum to telson of the largest specimens 25-30 mm.; and of "one very young one" taken by himself trawling in the Christianiafjord, at the depth of 60 fathoms.

Sars in the 'Oversigt af Norges Crustaceer,' 1882 (9), follows Boeck's classification, giving under Tribe II. *Gammarina*, Fam. I. *Trischizostomidæ*, one genus, *Trischizostoma*, one species, *T. raschii*.

In 1885, Carus in his 'Prodromus' (10) places *Guerinia* in the subfamily *Phoxinæ* of the Gammaridæ between the genera *Lilljeborgia* Sp. Bate, and *Gammarus* (Fabr.) Sp. Bate. His description appears to be a literal translation of Spence Bate's definitions (4). He notes *G. nicaensis* as peculiar to the Mediterranean fauna.

In 1886, Bovallius (11) established a new tribe *Synopidea*, intermediate between Gammaridea and Hyperiidea, in which he placed the family *Trischizostomatidæ*. He gives full descriptions and figures of the adult female and a young male (5 mm. in length) of *Trischizostoma raschii*. The peculiar aspect of the first gnathopods he discovered to be due to torsion in the adult, being wholly absent in the young form.

About 20 young specimens were taken by Bovallius in July 1871 at Tjøttø, Norway, 20 miles south of the Polar Circle, in 80 fathoms; in July 1880 he found some adult females, "parasites on, or in company with, an *Asterias*" in Hardangerfjord, S.W. Norway, in 250 fathoms, the largest of these measuring 22 mm. He mentions Capt. Collin as having obtained specimens from the west coast of Novaya Zembla.

Stebbing in 1888 (12), in his introduction to the 'Challenger' Amphipoda, p. xix, writes: "A connection between the Hyperina and the Lysianassidæ has already been indicated by Boeck, who placed the family *Prostomatidæ* at the head of the Gammarina,

in immediate sequence to the Hyperina because of the agreement which he considered to exist between that family and the Hyperidae and Orchestidae. The Prostomatidae are in close relationship with the Lysianassidae and might, in my view, well be included in the older family." Stebbing was the first to perceive the great resemblance between the Mediterranean and Norwegian forms, and says (p. 272) of *Guerinia niceensis*: "It is beyond doubt, generically, perhaps also specifically, identical with the later *Trischizostoma raschii* Esmark & Boeck, 1860"; and again (p. 321) of *Trischizostoma*, "the genus, at least, is assuredly a synonym of *Guerinia* Hope & Costa."

In 1890, Sars (13) demonstrated clearly that *Trischizostoma* is a true Lysianassid, basing his conclusion on the structure of the oral parts, anterior antennæ, posterior gnathopods, and the bi-articulate 3rd uropod, and pointing out that "the urosome, which Boeck considered Hyperiidæan in character, essentially differs by being divided into three distinct segments." He, therefore, places the genus in the family Lysianassidae, giving detailed descriptions and figures of the adult female and the young form. In the summers of 1890-91 Sars obtained several specimens, all females, most of them ovigerous, in the Thronhjemsfjord, on the common black dogfish (*Spinax niger*). The largest measured 28 mm.

Bonnier in his discussion of the "Lysianassides" (14) 1892, refers to the difficulty of differentiating between the various genera, and suggests "des diagnoses courtes basées sur les véritables différences morphologiques de la structure des somites et leurs appendices, ou des clefs dichotomiques permettant d'arriver au genre et à l'espèce par l'examen d'un petit nombre de caractères, sans avoir à comparer une à une les descriptions et les figures des nombreux types qui constituent la famille des Lysianassides." He first gives the characters common to the family, and then proceeds to characterise the different genera according to the structure of the 1st maxilla, the maxilliped, the 1st peræopod, the telson and the antennule. The 1st maxilla in particular he considers useful in characterising most of the forms; for example, the four genera, *Trischizostoma*, *Acidostoma*, *Acontostoma*, and *Amaryllis* are at once distinguished from the rest by the modification of the maxillary palp. He discusses at length the conclusions of Bovallius (11) and Sars (13), agreeing however entirely with Sars.

In 1893, Della Valle (15) in his 'Sistematica' gives 10 sub-orders of the Gammarina, the tenth, Lysianassidae, including the two genera—*Guerinia* and *Trischizostoma*. On p. 770 he points out that the essential characters for distinguishing the Lysianassid genera are—the peduncle of the anterior antennæ; the mandible; and the posterior gnathopod. In the table following, *Guerinia* and *Trischizostoma* (placed in close relation to *Amaryllis* and *Acidostoma*) are defined thus: "Nei gnathopodi anteriori dell'adulto l'articolazione del 3°, 4°, e 5°, articolo è tale che il margine



the female has been published hitherto. The figure given by Costa is evidently that of a female, but his specimens cannot be traced. The last mention of them is in the 'Annuario' (6), where they are referred to as forming part of the Collection of Crustacea sent to the Paris Exposition, 1867. The method of preservation is described, the specimens being dried and mounted in glass cells.

Though the geographical range of this species is wide, the specimens taken have been few in number: Costa's specimens; the three males described in Prof. Della Valle's work (15); a female from the Gulf of Genoa; two females from the Bay of Biscay, one taken by the 'Princesse-Alice,' and one by the 'Huxley'; and Mr. Tattersall's six specimens, all from the west coast of Ireland, three females and three males. Thanks to Mr. Tattersall's kindness in permitting me to examine these last and to dissect a male specimen, I have been able to satisfy myself that the oral parts taken by Della Valle as characters to differentiate the genera *Guerina* and *Trischizostoma* are really identical in structure in both forms. The first maxilla, in particular, which he describes as lacking the inner plate, and with the palp reduced to a small and simple tubercle, will be seen to possess not only the inner plate, but a minute, distinctly bi-articulate palp (Pl. XV. figs. 1 & 2). These structures, however, are so exceedingly fragile and pellucid as to render dissection very difficult. The little leaf-like palp arises in a small hollow inside the margin of the outer plate, and sets out at right angles to it; when mounted for the microscope the weight of the cover-glass is quite sufficient to depress it into the hollow, thus giving the effect of a little tubercle.

The description of the male is taken principally from the Irish specimen, 21.5 mm. in length; that of the female from the 'Huxley' specimen, 23 mm. in length. All the measurements are taken in the same way, from the tip of the rostrum to the tip of the telson, along the medio-dorsal line.

There is little difference between the sexes, the principal distinguishing characters being found in the antennæ.

The *Integument* is very characteristic, having the appearance of "pitting"; under a high power each little pit is seen to be irregularly six-sided and fringed with sharp spines (Pl. XIV. fig. 2).

The *Head* is much deeper than the peræon, about as long as deep; rostrum broad, apically rounded, curving right over the bases of the superior antennæ. The head is longer than the first segment of the peræon (2.5 mm. to 1.5 mm.), about as long as the first segment and half the second. *Eyes* large, dark brown in colour, the pigmented masses on each side numbering not less than 60 ommatidia, arranged in eight or nine transverse rows, with an irregular row of smaller unpigmented ommatidia entirely surrounding the pigmented masses and meeting in the medio-dorsal line.

**PERÆON.**—The 1st segment is the longest; the 2nd, 3rd, and

4th are shorter and subequal; the 5th is smaller again; and the 6th and 7th are the shortest of all and subequal. All, except the first, are produced at the posterior angles and rounded.

*Side-plates.*—About half as deep as the body (see peraeopod figs. for the correct proportions. They are not well represented in the figure of the whole animal owing to the immense distension of the ovisac forcing them out of the normal position). The 1st is small, triangular, almost entirely covered by the large 2nd. This side-plate is the largest of all, greatly dilated inferiorly and produced forward, posterior margin straight. The 3rd is almost as deep as long, with the anterior distal angle produced forward, posterior margin straight, inferior margin rounded; the 4th is similar, but smaller; the 5th and 6th successively smaller, inferiorly bilobed; the 7th is the smallest, subquadrate.

*PLEON.*—First three pleon segments subequal, large, equalling the first peraeonal segment in length. Epimeral plates large and rounded, the 2nd and 3rd with a lateral carina which in the 2nd terminates in a denticle at the postero-lateral angle. The 4th segment is deeply depressed dorsally; the 5th is shorter than the 4th or 6th; the 6th is depressed dorsally and emarginate for the insertion of the telson.

*SUPERIOR ANTENNA.*—*Female* (Pl. XIV. fig. 3). The first joint of the peduncle is as long as the two following taken together, broader than long, with a fringe of about 24 of the so-called "auditory setæ" around the distal posterior angle, and 8 smaller similar setæ in a cluster on the proximal posterior margin.

The *primary flagellum* consists of one long broad joint and eight small. The 1st joint nearly equals the peduncle in length and is as long as the eight small joints taken together. It carries on its inner surface two longitudinal bands of laminar hyaline filaments (see fig.), about 38 transverse rows in each band. The 2nd joint widens distally and is furnished at the inner posterior angle with a long, rigid, slightly curved spine reaching to the tip of the flagellum; the 3rd has a similar but shorter spine inserted at the outer anterior angle. The 2nd, 3rd, 4th, 5th, and 6th joints are all fringed on the inner margin with a row of small, stiff, curved setæ, deeply inset; the apical joint is tipped with two long stiff setæ.

The *accessory flagellum* is inserted anteriorly in a deep emargination of the peduncle and is composed of one long laminar joint and two small ones.

The number and proportions of the joints appear to vary with the age of the specimen. The 'Huxley' specimen, just described, and one of the Irish specimens, 20.5 mm. in length, have each nine joints in the primary flagellum, with the first joint cylindrical and swollen. The other two Irish specimens, 20 mm. and 22 mm. respectively, have eight joints, the first joint much more slender, and incurved like that of the male, and the accessory flagellum much longer in proportion. These two females appear to be younger than the others—the claws and spines are much less worn.

*Male* (Pl. XIV. figs. 4 & 5).—This antenna is much longer in the male than in the female, measuring 5 mm. in a specimen 21.5 mm. in length, as compared with 3 mm. in a female specimen of 23 mm.

The *peduncle* is not so long as in the female. First joint nearly twice as long as the 2nd and 3rd taken together (measured along the inner surface) with the “auditory setæ” as in female.

The *primary flagellum* consists of nine joints. The 1st is half as long again as the others taken together; it is incurved and covered on its inner surface with dense masses of the long sensory filaments. The six following joints are narrow proximally, widening distally, and carrying on their inner margins fringes of the small, stiff, curved setæ, the 2nd and 3rd having the long rigid, outstanding spines as in female, and the 5th, 6th, and 7th each with a calceolus. The 8th and 9th are slender and cylindrical, the 9th tipped with one long stiff bristle, one long seta and one small one.

The *accessory flagellum* is much smaller than in the female, not reaching to half the length of the first joint of the primary. It is composed of one long laminar joint, one small joint slightly constricted in the middle, and a minute apical joint. The 1st joint has four small setæ inset on the distal margin; the 2nd one “auditory” and one simple seta; and the terminal joint has two of the “auditory” and two or three simple setæ.

**INFERIOR ANTENNA.**—*Female* (Pl. XIV. fig. 6). The 1st joint of the peduncle is produced posteriorly downwards in a thick laminar lobe; it is hollowed behind, and in this hollow lies the small 2nd joint with its large antennal cone; the 3rd joint is small, as wide as long; the 4th is more than twice the length of the 3rd; the 5th is not as broad as the 4th and very slightly longer.

*Setæ.*—The first three joints carry no setæ. The 4th is furnished on the posterior margin with seven long auditory setæ proximally and one at the distal angle; with eight tufts of small setæ on the anterior margin. The 5th has twelve of these tufts along the anterior margin, and a fringe around the anterior angle; with one small seta at the posterior angle.

The *flagellum* consists of 29 joints, the first the largest; 26 of these are short, wider than long, decreasing gradually in size, each with a row of setæ inset anteriorly above the distal angle; the three terminal joints are very slender, cylindrical, the apical joint having one long stiff bristle and one auditory seta.

In the Irish specimens the proportions of the joints of the peduncle are the same as described above; the number of joints in the flagella vary—the 20.5 mm. specimen having 27; the 20 mm. having 20; and the 3rd specimen of 22 mm. with 22.

*Male* (Pl. XIV. figs. 7, 8, 9). The first two joints of the *peduncle* as in female; the 3rd a little longer; the 4th twice the length of the 3rd; the 5th as long as the 3rd and 4th taken together, more slender than the 4th, narrow proximally, slightly curved, with the anterior margin concave.

*Setae*.—The first three joints are without setae. The 4th has twelve auditory setae on the posterior margin (fig. 9), eleven proximally and one at the distal angle; anteriorly it is provided with nine groups or rows of small setae set transversely on the margin, with one auditory and one small seta at the distal angle. The 5th joint has one auditory seta at the posterior distal angle; and, on the anterior margin, eleven of the small transverse rows of setae, with a fringe of setae and one auditory seta at the distal angle.

The *flagellum* is half as long again as the peduncle, filiform, much more slender than that of the female. It consists of 38 small joints; the first with the posterior margin shorter than the anterior, and the others with the anterior angle a little produced downwards, giving an oblique look to the articulations. The first 25, subequal in length, gradually decrease in width, the following joints being longer and narrower. Each joint bears anteriorly a little bunch of setae at the distal angle. There is a calceolus on each of the first three joints, then one on alternate joints to the 35th, the calceolus (fig. 8) being set on a little protuberance above the bunch of setae. The first joint also bears a large "Rheichzapfen." The three terminal joints are exceedingly slender, the apical one tipped with two setae.

In the second specimen, 21.5 mm. long, the flagellum is twice the length of the peduncle and consists of 40 joints, the terminal four very minute and without calceoli. The first four have each a calceolus, after which they occur on alternate joints to the 36th. The third specimen, 20 mm. in length, has lost the tips of both antennae; 33 joints still remaining on each.

*ORAL PARTS*.—*Upper and Lower Lips* (Pl. XIV. figs. 10 & 11). The upper lip is elongate, deeply hollowed, apex entire and produced forward. The lower lip is divided at the tip into two lobes, with a minute pellucid structure between the apices.

*MANDIBLE*.—*Female* (Pl. XIV. figs. 12 & 13). The large basal portion carrying the palp is produced forwards in a laminar process, with truncate cutting-edge, feebly spatulate, no molar. On the inner surface distally are three spinules.

The 1st joint of the *palp* is very small; the 2nd large, about six times as long as the 1st, broad, rounded anteriorly, carrying along the distal half of the anterior surface inside the margin a row of 25 long, curved bristles, with plain shafts and minutely serrate tips. The 3rd joint is lanceolate, as long as the 2nd, but only half the width, with 17 long bristles on the anterior margin of the right mandible, 18 on the left mandible. These bristles are plumose for half their length and curved, the distal three being more widely spaced, smaller and more curved than the others. At the apex of the joint, set at a different angle from the others and from each other, are two bristles, the apical one half the length of the other, which is the longest on the palp: the shafts are dentate on either side, and the tips are long, stiff and finely plumose. The greater part of the joint is thickly covered with fine transparent flat spines.

*Male* (Pl. XIV. fig. 14). The apex of the front part of the trunk is more spatulate than that of the female. The proportions of the joints of the *palp* vary a little also, the 3rd joint being slightly longer than the 2nd, which is more elongate in form than that of the female. The row of bristles on the 2nd joint commences lower down the margin; in the right mandible they number 34 on the 2nd joint, and 27 on the 3rd; the left mandible having 31 on the 2nd, and 26 on the 3rd. The numbers appear very variable. In the Mediterranean specimen examined they were: right mandible 37 and 26 respectively; and on the left 30 and 25.

FIRST MAXILLA (Pl. XV. figs. 1 & 2).—The *outer plate* is elongate, with five strong claws apically, four much curved, and serrated (see fig. 1, detail). The plate is contracted below the apex and again at the insertion of the *palp*. The small pellucid *inner plate* is of very delicate structure, unarmed. The *palp* is bi-articulate, minute, set in a hollow and united along its length to the inner surface of this hollow, the laminar leaf-like second joint being twice the length and breadth of the first.

There is practically no difference between the sexes, except that the first maxilla of the male is longer than that of the female and the apical claws are longer.

SECOND MAXILLA (Pl. XV. fig. 3).—Slightly larger in male than in female. *Inner plate* small, tipped with one setule; *outer plate* broad and rounded distally, hollowed underneath, with three setules on the apical margin and one on the inner side.

MAXILLIPEDS (Pl. XV. figs. 4 & 5).—*Female*. The basal joints deeply curved; the 2nd joint of the one maxilliped fused with that of the other for nearly three quarters of its length. *Inner plates* fairly large, narrowing apically, unarmed. *Outer plates* extending beyond the distal margin of the first joint of the *palp*; large, unarmed except for one or two microscopic setules.

The 1st joint of the *palp* is large and broad; the 2nd short, widening a little distally, with one seta at each angle; the 3rd is the largest of all (measured along the outer margin), lightly curved, with seven transverse rows of strong bristles on its under surface (see detail, fig. 5), and two setae on the inner distal margin. Distally the under surface of the joint is covered with a spinose armature similar to that of the mandibular *palp*. The 4th joint is subequal in length to the 2nd, narrow and unarmed.

*Male*. The basal portion and plates are the same as in the female, but the proportions of the joints of the *palp* vary.

The 1st joint is the longest; the 2nd the shortest, with one seta on its inner angle and two clusters of the long bristles distally on the outer margin; the 3rd joint is slightly shorter than the 1st, curved, densely setose on its under surface, with about ten transverse rows of long bristles; the 4th joint is subequal to it in length, but only half its width and unarmed.

FIRST GNATHOPOD (Pl. XV. figs. 6, 7, & 8) very powerful, with the chitinous margins of extraordinary thickness, and longi-

tudinal ridges of chitin on all the free joints. The 2nd joint is very long and curved; the 3rd, 4th, and 5th are subequal, the 3rd and 4th continuing the curve of the 2nd; the 5th with a longitudinal ridge produced to a point on each side of the articulation with the 6th (see fig. 6). The 6th or "hand" is usually carried as in fig. 6, immensely swollen, with the inner side (fig. 8) rounded and more swollen than the outer (fig. 7). The palm margin is bordered with strong, incurved, mobile teeth, 15 in number, each with a tubercle behind (see fig. 8, detail), and with five long, slender, mobile spines above the margin. The hand has the deep groove or channelling described by Costa, "*una scanalatura nella faccia esterna*," into which the acuminate tip of the long claw fits. At the prehensile angle, on the outer edge of this groove is a very long, mobile, curved spine, with a small one beside it, each with a tubercle posteriorly, while on the under edge are two medium-size spines, one larger than the other; all four spines are provided with small flagella. The powerful curved claw or "finger" is very long, longer than the palm margin, with 12 or 13 minute sensory setules along its inner surface.

The only difference between the sexes is—in the male the hand, while equally broad, is slightly longer than that of the female, and the palm margin is provided with more spines.

*Females.* In the 'Huxley' specimen, 23 mm., the width of the hand is 2.5 mm., with 5 long spines and 15 small teeth on the palm margin; hand figured (fig. 7). Of the Irish specimens, the first 20.5 mm. long measures 3 mm. across the hand, with 5 long and 16 small teeth, hand as fig. 6; in the second specimen, 20 mm., the hand measures 3 mm., 5 long and 18 small teeth, hand inverted; in the third female, 22 mm., the hand measures 2.75 mm., 5 long and 18 small teeth, hand as fig. 7.

*Males.* In the specimen figured, 21.5 mm. in length, the hand measures 3 mm., 6 long and 19 small teeth (fig. 6). The second specimen, 21.5 mm., is exactly similar; the third of 20 mm. length measures barely 3 mm. across the hand, 6 long and 18 small teeth, hand carried as in fig. 6.

SECOND GNATHOPOD (Pl. XVI. figs. 1, 2, 3, 4, & 5).—The 2nd joint is very long and slender, curved, widening distally; the 3rd is rather more than two thirds the length of the 1st, longer than the two following taken together, laminar, the distal half of the joint wider than the proximal; the 4th joint is small, narrow proximally, twice as wide at the distal end, rounded posteriorly, with the posterior margin twice the length of the anterior; the 5th is longer than the 4th, ovate elongate, narrow at both extremities, considerably expanded posteriorly; the 6th bends backward towards the 5th, almost discoidal in shape, as wide as long, very narrow proximally, but expanding both anteriorly and posteriorly. The 7th joint or claw is very minute, set transversely in the middle of the distal margin of the 6th, so that the point of the claw impinges against the under surface of the margin. It is completely concealed by the dense masses of setae, which is,

no doubt, the reason why it escaped detection by Costa (2) ("privo affatto di unghia").

*Setæ*.—The 2nd, 3rd, and 4th joints each carry a seta at the posterior distal angle; the 5th is covered on the anterior and posterior surfaces with dense masses of delicate, hyaline, sensory hairs (fig. 4), with a fringe of long jointed setæ at the anterior angle, and four clusters of the same along the posterior margin (for detail see fig. 5). The 6th joint is thickly covered with the hyaline hairs, with a large number of the jointed setæ anteriorly, increasing in length to the anterior angle, the longest being twice the length of the joint; the posterior angle also bears a cluster of shorter, jointed setæ. These "hyaline hairs" and "jointed setæ" are peculiar to the 5th and 6th joints; the 6th joint having yet another kind, stiff, curved, and serrate, similar to that figured for *T. raschii* (Pl. XX. fig. 3). A cluster of about four to six of these is to be found on each side of the claw, and three just beyond its tip. The claw itself is denticulated on its under surface, and the portion of the margin against which it impinges is thickly dentate (fig. 2).

PERÆPODA.—Branchial vesicles occur on all the peræopoda, long and much pleated on the first and second, shorter and more divided on the three posterior pairs. Incubatory lamellæ are attached to the first three, as well as to the second gnathopod. The sixth joint of each peræopod is produced over the base of the claw in two delicate transparent plates, or "dactyloptera" (see Spence Bate, 4. p. 317), with pectinate margins (Pl. XVI. fig. 6). The tactile spines of the peræopoda and uropoda are of similar construction. Each consists of a stout shaft, blunt-tipped, carrying subapically a slender flagellum (cf. Pl. XVII. fig. 3).

FIRST PERÆPOD.—*Female* (Pl. XVI. fig. 7). 2nd joint long, a little longer than the two following taken together, expanded, rather narrowed proximally; 3rd very small; 4th long, a little dilated anteriorly, 5th subequal to the 4th in length; 6th longer than the 5th, narrow; the 7th or claw moderately curved, about half the length of the 6th.

*Setæ*.—The 2nd and 3rd joints each carry one seta at the posterior angle. The 4th has, anteriorly, one small seta and one large spine at the distal angle, with three setæ along the posterior margin and one at the angle. The 5th has two setæ at the anterior angle; one at the posterior, and four along the margin. The 6th has one small seta at the anterior angle; the posterior margin is dentate, with seven strong setæ inserted at intervals along it. The claw is provided with eight denticles on the proximal half of the inner margin.

*Male*. 2nd and 3rd joints as in the female; 4th and 5th slightly longer, the 6th and 7th distinctly longer, than in the female.

*Setæ*.—The posterior margins of the 4th and 5th have each one seta more, and the 6th two setæ more, than the female; the posterior margins of both the 5th and the 6th are dentate; the claw with ten denticles.

SECOND PERÆPOD.—*Female* (Pl. XVI. fig. 8). Very similar to the first peræopod, but with the 2nd, 3rd, 4th, and 5th joints shorter; the claw is equally as long; the 2nd joint a little more expanded than in the first peræopod; the setæ on the joints much less in number; claw without denticles.

*Male*. 2nd, 3rd, 4th, and 5th joints as in the female; 6th and 7th longer.

*Setæ* as in the female.

The THIRD PERÆPOD is the shortest of all.

*Female* (Pl. XVI. fig. 9). The 2nd joint long, broadly oval, anteriorly rounded, posterior margin laminarily expanded and produced a little downwards, widest proximally. The 3rd small; the 4th and 5th practically subequal, the 4th a little dilated posteriorly. The 6th is nearly as long as the 2nd, narrow. Claw moderately curved, nearly two thirds the length of the 6th.

*Setæ*.—The 2nd joint has one minute sensory setule indented in the middle of the posterior margin and three in the anterior margin, with one large spine at the anterior angle. The 3rd carries one spine on the anterior angle. The 4th has one spine and two or three of the sensory setules posteriorly; with four spines on the anterior margin and two at the distal angle. The 5th has three on the anterior margin and two at the angle. The 6th is provided posteriorly with three minute setules and anteriorly with five spines. The claw is apparently without denticles.

The branchial vesicle extends to the distal margin of the 5th joint.

*Male*. The 2nd joint is as long as the 2nd and 3rd taken together in the female, with the anterior margin lightly concave; the following joints a little longer, the 6th decidedly so.

*Setæ*.—As in the female, except that the 6th is furnished with a few scale-like spines on the anterior distal angle, and the claw bears four denticles.

FOURTH PERÆPOD.—*Female* (Pl. XVI. fig. 6, Pl. XVII. fig. 1). 2nd joint long, lightly concave anteriorly, laminarily expanded posteriorly, and a little produced downwards; the 3rd small; the 4th and 6th subequal to each other in length; the 5th shorter than the 4th or 6th; 7th half the length of the 6th.

*Setæ*.—The 2nd joint has one minute sensory setule inserted midway on the posterior margin and one spine at the anterior angle. The 3rd carries one at the anterior angle. The 4th has four on the margin, and one large one at the angle posteriorly; with four at the anterior angle and six on the margin, two of these being inserted in the same indentation, one a little behind and below the other, an arrangement characteristic of the hinder peræopoda. The 5th carries two of these pairs and two single spines on the anterior margin, and three large spines on the angle, which is produced underneath in a pectinate fringe (*cf.* Pl. XVII. fig. 3). The 6th bears five spines on the anterior margin, the distal half of which is dentate. The claw is provided with two denticles.



*Male.* The proportions of the joints to each other are the same as in the female, but all are longer, the 2nd, for example, equalling the 2nd and 3rd of the female taken together.

*Setæ* practically the same as in the female. The 5th has three pairs and two single spines; the 6th one pair and five single, with the distal half of the margin dentate; the claw has four denticles.

**FIFTH PEREOPOD.**—*Female* (Pl. XVII. figs. 2 & 3). 2nd joint long, a little concave anteriorly with an oblique groove midway along the margin in which the branchial vesicle rests, less expanded posteriorly than the preceding pereopod; 3rd small; 4th as long as the 2nd and longer and broader than the 5th or 6th; 5th and 6th subequal; 7th half the length of the 6th.

*Setæ.*—This pereopod is armed anteriorly with a formidable array of spines. The 2nd joint has the one minute setule posteriorly; one large spine on the anterior angle. The 3rd has one large spine. The 4th carries six on the margin and one at the angle posteriorly; one pair and six single on the margin and three at the angle anteriorly. The 5th has three of the sensory setules and one spine posteriorly; the anterior margin dentate with six pairs and one single spine inset and three at the angle (fig. 3). The anterior margin of the 6th is also dentate with one pair and five single spines inset; four sensory setules posteriorly. The claw is provided with five denticles (seven in another specimen).

*Male.* Proportions of the joints to each other as in the female, but all longer.

*Setæ.*—Nine spines on the anterior margin of the 4th joint; three pairs and four single spines on the 6th, the rest as in the female; five denticles on the claw (three on the Mediterranean specimen).

**PLEOPODS** (Pl. XVII. figs. 4, 5, 6, 7).—The peduncles are large and stout, with two little coupling spines (fig. 5). The rami are about twice the length of the peduncles. The *outer ramus* has 22 articulations, the long first joint carrying on both margins proximally a tuft of fine hyaline sensory hairs with flattened tips; the inner ramus is provided with similar tufts and has six cleft spines (fig. 7) on the inner side of the first joint, with an uncinatè plumose seta (fig. 6) on each of the following thirteen joints on the inner side.

**UROPODS** (Pl. XVII. figs. 8, 9, 10).—The peduncles are large and stout; that of the 1st uropod longer than the rami; that of the 2nd subequal to the rami in length; while in the 3rd the rami are slightly longer than the peduncle. The apices of the 1st uropods reach considerably beyond the peduncles of the 3rd; those of the 2nd and 3rd are almost on a level (fig. 8). The rami of the 1st and 2nd pairs are greatly curved.

The *first uropod* has seven small spines on the inner margin of the peduncle which is serrated for half its length, with small serrations along the distal margin also. The *outer ramus*

is shorter than the inner, with the outer margin armed with scale-like spines and the inner with strong teeth (fig. 10). The inner ramus has the margins serrated (fig. 9), the under margin beset with two spines in the female and four in the male.

In the *second uropod* also, the outer ramus is shorter than the inner. The peduncle is serrated along the distal margin and around the inner angle, with two spines on the angle. The rami as in the first uropod but without spines. The outer ramus of the *third uropod* is bi-articulate, with a spinule inserted at the outer distal angle of the first joint; all the margins serrate.

TELSON (Pl. XVII. figs. 11 & 12) as broad as long, margin entire. It carries four oblique rows of microscopic spinules, two on each side of the medio-dorsal line, the distal rows longer than the proximal. It is also provided with two rows of tufted setules, four on one side and three on the other (fig. 12), each set in a little pocket (cf. *T. raschii*, fig. 13). These tufted setules are peculiar to the telson.

The principal *points of difference* between this species and the following, are:—The shape of the rostrum, curved in *T. niceense*, horizontal in *T. raschii*; the size and number of the ommatidia; the shape of the 2nd, 3rd, and 4th side-plates; the 2nd maxilla, the inner lobe small in *T. niceense*, subequal to the outer in *T. raschii*; the maxilliped palp, the first joint long, the second short in *T. niceense*, the reverse in *T. raschii*; the shape of the hand of the first gnathopod; the 1st and 2nd pereopods, the 2nd joint being dilated in *T. niceense*, the 4th in *T. raschii*; the shape of the 2nd joint of the 3rd pereopods; and lastly the shape of the telson, the margin entire in *T. niceense*, excavated in *T. raschii*.

TRISCHIZOSTOMA RASCHII Esmark & Boeck, 1860. (Plate XVII. fig. 13; Pls. XVIII., XIX. figs. 2-11; Pls. XX., XXI. figs. 1-13, 15-18.)

Syn. 1860.	<i>Trischizostoma raschii</i>	Boeck (3).
1865.	"	" Lilljeborg (5).
1870.	"	" Boeck (7).
1872.	"	" Boeck (8).
1886.	"	" Bovallius (11).
1890.	"	" Sars (13).
1893.	"	" Della Valle (15).
1906.	"	<i>niceense</i> ♀ Stebbing (19).
1907.	"	<i>raschii</i> Stebbing (20).

The measurements quoted in the following description are taken from three specimens: an adult female from Norway, measuring 26 mm. from the tip of the rostrum to the tip of the telson; the immature specimen from the West of Ireland, 9 mm.; and a young one taken from the incubatory pouch of the first specimen, 7 mm. long. The female had seven young still remaining in the ovisac; the measurements of their appendages etc.

do not vary by the fraction of a millimetre. The intermedite specimen appears to be an immature female; no incubatory lamellæ are developed, but the proportions of the antennal joints agree with the adult form.

*Head*.—Much deeper than the pereon, as long as deep; rostrum horizontal, apically rounded. In the *adult* the head is slightly longer than the first segment of the pereon (3 mm. to 2.5 mm.); in the *immature* it is much longer; and in the *young* it is nearly twice as long (as 9 : 5). The huge *Eyes* cover nearly the whole surface of the head; they are composed of a great number of small, dark brown ommatidia, arranged in rows, with one row of unpigmented ommatidia following the contour of the pigmented mass and meeting in the medio-dorsal line. There are not less than 154 of the dark ommatidia, each side, but they are too closely crowded together to permit of ascertaining the exact number.

In the *immature* the eyes are reniform, almost but not quite touching dorsally, and not extending so far forward or downward as in the adult; not less than 120 pigmented ommatidia. In the *young* a large number of unpigmented ommatidia.

*PEREON*.—The 1st segment of the pereon in the adult is the largest, the four following subequal, the 6th and 7th the smallest, all, except the first, produced at the posterior angle and rounded.

*Side-plates*.—*Adult* (see pereopoda figures). The 1st is very small, triangular, almost completely hidden by the 2nd, which is greatly dilated inferiorly, forming a large triangular lobe, reaching anteriorly to the infero-lateral margin of the head, and produced to a great length downward posteriorly, slightly emarginate behind. The 3rd is in shape obliquely oval, anterior margin convex, posterior emarginate, less than half as wide and slightly shorter than the 2nd. The 4th is shorter again, rounded anteriorly and deeply emarginate posteriorly, inferior margin truncate. The 5th is bilobed, posterior lobe deeper and wider than the anterior; 6th of similar construction, much smaller. The 7th is the smallest, wider than deep, with rounded corners. In the *immature* specimen the proportions of the pereon segments and side-plates are the same as in the adult.

*In young*. The first pereonal segment is the largest, all the others subequal; body deep; side-plates not so large in proportion as in adult, those of the second segment differing a little in shape.

*PLEON*.—*Adult* (Pl. XVIII. fig. 1). The first three segments large and subequal, the 1st pleon segment equalling the first pereonal segment in length (measured along the medio-dorsal line). Epimeral plates large and rounded; those of the 2nd segment with a diagonal carina terminating in a denticle at the postero-lateral angle, and those of the 3rd segment almost rectangular; 4th segment with a deep depression dorsally; 5th and 6th smaller, the 5th being slightly shorter than the 6th, which is emarginate dorsally, for the insertion of the telson.

*Immature.* The proportions are the same as in the adult.

*Young.* First three pleon segments a little longer proportionately than in adult, the plates rounded inferiorly, no trace of lateral carina in second.

**SUPERIOR ANTENNA** (Pl. XVIII. figs. 2 & 3).—In the *adult* female, the 1st joint of the peduncle is twice as long as the other two taken together, broader than long, posterior margin concave, carrying a series of auditory setæ distally; the 2nd joint also has three or four of these setæ distally; the 3rd joint is deeply excavated anteriorly for the insertion of the accessory flagellum.

The *primary flagellum* consists of ten joints; the 1st equalling the first joint of the peduncle in length, and so broad as to appear a continuation of it. It carries, on its anterior surface, a great number of broad, hyaline, sensory filaments, arranged in two longitudinal rows, about 22 groups of the filaments in each row. The 2nd joint is short, widening distally, with a fringe of short stiff setæ at the anterior distal angle; the 3rd joint is produced at the anterior distal angle for the insertion of a long curved spine which reaches nearly to the tip of the flagellum; the 4th joint is cylindrical with a much shorter similar spine, and with a transverse row of small setæ in the middle of the anterior margin; these three joints have each a row of setæ inset midway along the posterior margin. The following four joints decrease gradually, each carrying at the distal anterior angle a fringe of small setæ. The apical joint is very small, with one long stiff bristle and two auditory setæ.

The *accessory flagellum* consists of one long laminar joint and three small joints. The 1st equals in actual length the first joint of the primary flagellum; it carries three groups of long setæ on its upper margin, with a group of six setæ at the distal angle, two long, two short, and two "auditory." The 2nd joint is very small, cylindrical, rounded, with two long setæ and one auditory distally; the 3rd is longer and more slender than the second, slightly constricted in the middle, with one long seta and one auditory; the apical joint is minute, furnished with a long stiff bristle and three setæ.

As stated before, the number of joints in the flagella of the antennæ appears to vary with the age of the specimen. In the primary flagellum, the adult has 10, the immature 7, and the young 4; in the accessory flagellum, the young form has only one small joint, the immature specimen has two, and Boeck, Bovallius, and Sars record the number as two for the adult, but in the specimen here described there were three (fig. 3). The inferior antennæ also show this variation, the adult having 25, the others 10 and 4 respectively.

In the *immature* specimen (Pl. XVIII. fig. 4) the 1st joint of the peduncle is not so long in proportion as in the adult; the 2nd and 3rd are subequal, taken together not so long as the first. The *primary flagellum* has 7 joints; the first joint large and stout, furnished with two rows of the sensory filaments,

about 10 groups in each row; the remaining six joints taken together are twice the length of the first. The *accessory flagellum* is tri-articulate.

In the *young* form (Pl. XVIII. fig. 5) the 2nd and 3rd joints of the peduncle taken together are equal in length to the 1st. The primary flagellum is very little longer than the peduncle, and is composed of four joints, the 1st the longest; the 2nd and 3rd are each armed with a stiff spine, similar to those of the adult; the apical joint is tipped with a long bristle, four simple setæ, and one auditory. The *accessory flagellum* is biarticulate, and much longer than in the adult, equalling the first and second joints of the primary flagellum taken together. There is an auditory seta on each joint.

INFERIOR ANTENNA.—*Adult* (Pl. XVIII. fig. 6). About twice the length of superior antenna. The 1st joint of the *peduncle* is produced posteriorly in a thick lobe, a little hollowed behind; the 2nd joint is small, the antennal cone large in proportion; the 3rd is as wide as long, broadening distally; the 4th exceeds the 5th in length and is much broader. The first three carry no setæ; the 4th has twelve long auditory setæ along the posterior margin, nine of which are inset on the inner surface and three on the outer; the anterior margin carries seven groups of long fine setæ proximally, and seven clusters of small setæ arranged in transverse rows across the margin; six of these little groups are continued down the 5th joint. At its distal posterior angle there is one long auditory and one simple seta.

The *flagellum*, which is about a third longer than the peduncle, has 25 joints, the first the largest, decreasing gradually to the tip which carries one long stiff bristle, two fine setæ, and one small one; each joint has a row of small setæ anteriorly, inset a little above the distal angle.

In the *immature* form the proportions of the peduncle joints are the same. The 4th joint carries six of the auditory setæ; the 5th has four setæ at intervals on the anterior margin and one auditory one distally, and one auditory and one fine seta posteriorly as in adult. The flagellum has only 10 joints, the first the largest; all the joints are provided with the little rows of setæ as in adult.

In the *young* (Pl. XVIII. fig. 7) the flagellum is shorter than peduncle and consists of only four joints, the first of which much exceeds the other three taken together in length, each furnished distally with a cluster of rather long setæ, the apical joint carrying one long stiff bristle and four small setæ.

ORAL PARTS (Pl. XVIII. fig. 8).—*Upper and Lower Lips* (figs. 9, 10, & 11). The upper lip is elongate, apex emarginate; the lower lip is of a more delicate structure, bifid, with the lobes lanceolate; both lips so hollowed as to appear very narrow, but when flattened out, of considerable breadth.

MANDIBLES (Pl. XVIII. fig. 12).—Strong basal portion carrying the large palp, produced forward as a long narrow process;

cutting-edge obliquely truncate; no molar. The 1st joint of the *palp* is very short, twice as broad as long; 2nd joint long and broad, with a series of long stiff bristles commencing at the posterior distal angle and crossing the joint to the anterior margin, where it is continued downwards in a double line for half the length of the margin. These bristles, numbering 50, are closely crowded, and are inserted inside the margin on the outer face; on the under side there are 5 large strong ones inset at intervals on the margin. The 3rd joint equals the second in length. This joint is covered with a dense mass of fine transparent spines giving it a furred appearance. It is furnished with 15 long, curved, plumose bristles along the anterior margin, inset on the under side, the distal three forming a distinct group, shorter, more curved, and at wider intervals than the others. At the apex are two bristles set at a different angle from the others and from each other, the upper one the shorter of the two, both with dentate shafts and plumose tips.

In the *young* (Pl. XVIII. fig. 13) the 1st joint of the *palp* is longer in proportion, the second joint being only three times its length, instead of five times as in the adult. The 2nd joint is shorter than the third, with no bristles developed; the 3rd has the two apical bristles, the distal one of the small group, and the distal one of the long series.

FIRST MAXILLA.—*Adult* (Pl. XVIII. figs. 14 & 15; cf. also Pl. XIX. fig. 1). With *outer plate* elongate, contracted below the apex, and divided at the tip into five large claw-like teeth, four of them much curved; the fifth is not at the same level but set a little farther down on the inner side, with a small spine at its base on the inner margin, and a tuft of fine setæ just below. The *palp* is small, bi-articulate, set broadside on, the first joint very minute, the second twice as long and tipped with two setules, one longer than the other. The *inner plate* is very small, not a quarter the length of the outer portion, unarmed, of delicate structure.

In the *young* (Pl. XIX. figs. 2 & 3) the *inner plate* and the *palp* are much longer in proportion. The *outer plate* is rounded at the apex, the five teeth not being separated as in adult. The *palp* is bi-articulate, the two joints subequal, the apex tipped with two setules.

SECOND MAXILLA.—*Adult* (Pl. XIX. fig. 4). The two plates almost equal, the *inner* slightly the shorter, both hollowed underneath, giving the appearance of much less than their actual breadth. The *outer plate* carries two minute setules at the tip, one inset at the outer surface and one on the inner, and a few hyaline, sensory setæ on the inner margin. The *inner plate* has the apex obliquely truncate, beset with three setules, the distal one the shortest. This plate also has a few of the hyaline setæ.

In the *young* (fig. 5) the proportions are the same, the plates being rounded at their apices.

MAXILLIPEDS.—*Adult* (Pl. XIX. fig. 6). The maxillipeds are

deeply curved and hollowed, forming the lower portion of the oral tube; the second joint of the one maxilliped is fused with that of the other for more than two-thirds the length. *Inner plates* narrow, linguiform, tipped with two spinules; *outer plates* large, hollowed, so close together as to conceal the inner plates, armed on the inner edge with ten uncinat spinules.

The *palp* is geniculate at the middle. The 1st joint is the shortest, broad distally; the 2nd and 3rd successively longer; the 4th considerably the longest of all, being twice the length of the first, lanceolate, one setule apically, finely serrated on both margins, the serrations being stronger on the inner edge.

*Setae*.—The 1st joint has one small seta at the inner angle; the 2nd carries three long setae on its outer angle; the 3rd has one proximally inside the margin on the outer surface, two clusters on the margin, and a fringe of six around the outer angle, with three on the inner angle.

In the *young* (fig. 7) the 3rd joint is the longest; the 2nd and 4th subequal to each other in length.

The 1st joint has one small seta; the 3rd carries one at each distal angle, while the 4th has the apical setule and the margins not serrated.

FIRST GNATHOPOD.—*Adult* (Pl. XIX. fig. 8). The 2nd joint is very long, slightly curved, widening a little at the distal end; the 3rd and 5th are subequal in length; the 4th is the smallest, greatly curved, the outer margin of the joint being five times as long as the inner. The 6th joint or "hand" is bent over to such an extent that the articulation of the finger, normally situated at the infero-anterior angle, appears to originate from the infero-posterior corner instead, and what would normally be the under surface thus becomes the upper. The curve backwards is so extreme that this articulation almost touches the third joint, and the fourth and fifth are nearly hidden on the outer side. The hand is enormously developed, rounded-triangular, greatly inflated, more so on the upper side. The palm margin is straight with 15 strong recurved teeth, gradually decreasing in size posteriorly. At the extreme anterior angle is a small groove into which the tip of the "finger" fits. On the upper edge of this groove are two strong spines; on the under edge three spines, with large tubercles at the bases of two of them. One of these spines is minute, one broad and strong, similar to the upper ones; and the third, strong, tapering, mobile, is situated at the anterior end of the row of teeth, reaching, when close against the palm, to the base of the sixth tooth. The "finger" or claw is large and curved, not extending beyond the palm margin. There are no setae on any of the joints.

*Immature* (Pl. XIX. fig. 9).—The second joint is much more curved than in adult. The hand sets out more, at right angles to the other joints. The small teeth number 15, the posterior five being barely visible, and there are two very large mobile spines at the anterior angle and two smaller just appearing.

*Young* (Pl. XIX. fig. 10).—The proportions of the first five joints are the same as in adult, but the hand differs somewhat. It is held in the normal position, not inverted, though showing a tendency to curvature. It is more ovoid in shape, produced posteriorly beyond the palm limit, which is defined by a spine opposed to the tip of the claw. Close to this spine, one small tooth can be seen, the distal one of the small series. None of the joints is furnished with setæ except only the claw, which has two minute ones at the tip.

The hand is much larger in the young in proportion to the size of the animal than in the adult; measured across the widest part, in the *young* it is 1.5 mm. to 7 mm. of total length; in the *immature* 2 mm. to 9 mm. total length; and in the *adult* 3.75 mm. to 26 mm.

SECOND GNATHOPOD.—*Adult* (Pl. XIX. fig. 11; Pl. XX. figs. 1, 2, 3, 4, & 5). The 2nd joint is long, broadest distally; the 3rd nearly as long as the second; the 4th short, narrow proximally, rounded posteriorly with the posterior margin twice as long as the anterior; the 5th is nearly as long as the third; the 6th is broadly ovate, only half the length of the fifth, very narrow at the base, but expanding laminarily on both sides; the 7th or claw is minute, nearly hidden under the long setæ, and situated in the middle of the distal margin of the sixth.

*Setæ*.—There are no setæ on the 2nd joint; one small one distally on the 3rd; a little fringe of fine setæ on the posterior margin of the 4th, with three small spines across the distal angle; the 5th is furnished with two dense masses of very delicate, hyaline hairs (fig. 5), one mass covering the anterior surface and the other the posterior. At the anterior angle is a fringe of 12 strong, flexible setæ, reaching to the distal margin of the succeeding joint. Each seta consists of a stout shaft, finely and transversely serrated for half its length, with a slender flagellum (see fig. 4). Another cluster of these setæ, shorter in length, appears at the posterior distal angle and extends partway under the joint. These two kinds of sensory setæ, the "hyaline" and the "jointed," are peculiar to the 5th and 6th joints of this gnathopod. The 6th joint is nearly covered with the hyaline hairs, with two thick tufts on the distal angles; the posterior angle has a small group of the jointed setæ; while on the anterior angle is a cluster of about 50, the longest being twice the length of the joint. On the distal margin are two small clusters of the stiff, slightly curved, serrated bristles peculiar to this joint (fig. 3). They are placed one on either side of the claw, the group on the upper surface of the joint containing three bristles and that of the under side four; between them is the denticulated groove into which the claw fits. Bordering this groove are 6 stout sensory spines, three on each side, with their thick shafts embedded for two thirds their length, and their large flagella reaching beyond the apices (fig. 1). The curved under surface of the claw is also covered with minute denticles. It is provided



with a distinct nail and bears on its distal margin one small bristle, similar to those of the lateral clusters.

The large *branchial vesicle* reaches to the distal margin of the 3rd joint.

The *incubatory lamella* is lanceolate in shape, and extends to the distal margin of the 2nd joint. It is bordered with fine, delicate setæ of great length, the tips of which are slightly expanded (fig. 2).

In the *young* (Pl. XX. figs. 6 & 7) the 3rd joint is only half the length of the 2nd; the 4th is small, half as long as the 5th, which equals the 3rd. The 6th is much larger than in the adult, rounded, with the two masses of hyaline hairs, and four of the long, jointed setæ on the anterior angle. The claw also is much larger, with a distinct nail, three strong setæ at the tip, and one on the distal margin.

*Setæ*.—The 2nd, 3rd, and 4th joints each carry one small seta near the posterior angle; the 5th has two of the long jointed setæ posteriorly, one small seta anteriorly, no hyaline hairs developed.

**PEREPODA.**—The 1st pereopod is the longest, the 3rd the shortest; the three posterior pairs successively increase in length. Branchial vesicles are attached to all; incubatory lamellæ to the first three.

**FIRST PEREPOD.**—*Adult* (Pl. XX. fig. 8). The 2nd joint is very long, broad; 3rd short; the 4th long, with a laminar expansion anteriorly; the 5th ovate, shorter than the 4th; the 6th narrow, subequal to the 4th; the 7th half the length of the 6th, with a distinct falciform nail, the posterior margin with a slight excavation proximally.

*Setæ*.—The 4th joint carries five spines anteriorly; these spines are similar in construction to those of *T. nicæense*, but with the flagellum much shorter and nearer the apex. There is one spine at the posterior angle, and, indented in the posterior margin, are two small sensory setules. The 5th joint carries three of these setæ anteriorly, two posteriorly, and six spines around the posterior angle, one considerably larger than the others. The 6th and 7th have their posterior margins thickly dentate, the anterior margins serrate, the sixth joint with three spinules inset in the posterior fringe, two in the anterior, and three at the anterior angle.

The branchial vesicle at its widest is only half the width of the one attached to the second gnathopod.

The *immature* has the 4th joint expanded.

In the *young* (Pl. XX. fig. 9) the proportions of the joints are very different, the 4th, 5th, 6th, and 7th being practically subequal. The 4th joint is not expanded.

*Setæ*.—The 2nd, 3rd, 4th, and 5th are each provided with a small seta at the posterior angle, the 6th with one at the anterior angle.

**SECOND PEREPOD.**—*Adult* (Pl. XX. figs. 10 & 11). 2nd joint

broad, and as long as the two following taken together; 4th long and very broad, laminae expanded on both sides; 5th half the length of the 4th, ovate; 6th narrow, much shorter than the 4th; 7th half the length of the 6th.

*Setae*.—The 3rd joint has one small seta on the posterior angle. The 4th has six spines anteriorly inset along the chitinous margin on the upper surface; and, on the posterior margin, 14 or more microscopic sensory setules set in little indentations. The 5th carries one spine anteriorly, and four (2 large and 2 small) on the posterior angle; the posterior margin has four of the minute setules, and is thickly dentate along its distal half. The 6th and 7th as in the first pereopod, the 7th having several minute spines on its upper surface.

In the *immature* the 4th joint is expanded, about twice the width of the succeeding joint.

In the *young* (Pl. XXI. fig. 1) the 4th joint is hardly longer than the 5th, and not expanded; the 6th is the second longest joint of the pereopod.

Setae as in the first pereopod.

THIRD PEREOPOD.—*Adult* (Pl. XXI. fig. 2). Second joint as long as the three following taken together, laminae expanded, anterior margin rounded, posterior straight; the posterior part is produced downwards with its lower margin truncate. 3rd joint very small; 4th long, a little dilated posteriorly; 5th and 6th shorter than the 4th and much narrower; 7th about two thirds the length of the 6th.

*Setae*.—The 2nd, 3rd, and 4th joints have each, at the anterior angle, one strong spine; the 4th also bears at intervals along the anterior margin six small spines, and four larger ones posteriorly. The 5th has one large one midway on the posterior margin, and two at the anterior angle; the whole of the anterior margin as well as that of the 6th and 7th joints is strongly dentate, the 5th and 6th each having two small spines inset.

In the *young* (Pl. XXI. fig. 3), the 2nd joint is not so long nor so expanded as in the adult; the 4th and 5th are subequal; the 6th and 7th are subequal and a little longer than the preceding.

*Setae*.—The 2nd, 3rd, 4th, and 5th joints each carry one seta at the anterior angle; the 6th has two at the posterior angle.

FOURTH PEREOPOD.—*Adult* (Pl. XXI. fig. 4). The 2nd joint is long, laminae expanded, with both margins rounded; the posterior margin is produced downwards, lobate. The 4th is a little dilated posteriorly, a little longer than the 5th and 6th which are subequal; the 7th is about two thirds the length of the 6th; the nail small and straight.

*Setae*.—The 2nd joint is furnished at its anterior angle with one large spine and seven long fine setae extending beyond the succeeding joint. These setae have each a slender shaft, with a fine hair-like tip. Indented on the posterior margin are five very minute sensory setules. The 3rd joint has two spines; the

4th, five large ones posteriorly, five small on the anterior margin, and three large on the anterior angle; the 5th carries one on the posterior margin, two on the anterior, and two at the distal angle; and the 6th has two anteriorly. The distal half of the anterior margin of the 5th and the whole of the anterior margins of the 6th and 7th are dentate. The 7th joint is serrate posteriorly.

In the *young* (Pl. XXI. fig. 5) the joints are slightly longer than in the preceding pereopod, but the proportions are the same.

**FIFTH PEREPOD.**—*Adult* (Pl. XXI. fig. 6). The 2nd joint is longer and narrower than that of the preceding pereopod, concave anteriorly, rounded posteriorly and produced downwards in a deep lobe; the 4th, 5th, and 6th successively shorter and narrower, the 4th slightly dilated posteriorly; the 7th small and straight, much shorter than in the other pereopods, not quite half the length of the 6th.

*Setae*.—The 2nd joint has five minute sensory setules posteriorly so deeply inset as to give a crenulated appearance to the margin. The 2nd and 3rd joints at their anterior angles each have five large spines. The 4th has nine large strong spines set in deep indentations of the posterior margin, and seven smaller along the anterior margin, with four at the anterior angle—one large and three small. The 5th carries one small one on the margin, and one at the angle posteriorly; its anterior margin is strongly dentate with five spines inset along the proximal half, the two distal ones being placed together in the same indentation; at the anterior angle are four spines, one large and three small. The 6th has the anterior spinose fringe with two small spines inset; the anterior angle carries three, and the posterior two. The 7th joint is also dentate anteriorly; the nail minute, not falcate. The *branchial vesicle* attached to this pereopod is very small.

In the *young* (Pl. XXI. fig. 7) the 2nd joint is expanded; the 4th, 5th, and 6th are successively longer, not shorter as in the adult; the 7th is curved, equalling the 6th in length.

*Setae*.—The 2nd joint has one setule on the posterior margin; the anterior angles of the 2nd, 3rd, and 4th have each one, that of the 5th carries three, while the 6th has one at each angle.

**PLEPODA.**—*Adult* (Pl. XXI. fig. 8). The pleopoda are large and powerful. The *peduncle* is stout, with two little coupling-spines on the inner side, of the same construction as those figured for *T. niceense*; the rami twice the length of the peduncle, and subequal. The *outer ramus* of the 1st pleopod consists of 21 joints, the first much the largest, carrying six plumose setae on each side in addition to the distal two; the remaining 20 joints successively decrease in size, each furnished with two long plumose setae. The 1st joint of the *inner ramus* bears on its inner side a tuft of fine hyaline hairs and eight cleft spines; the seta at the inner angle of each of the 13 following joints is uncinata. The inner ramus of the 3rd pleopod has seven cleft spines and fifteen uncinata setae.

In the *young* the peduncle is much longer in proportion, with one seta on the outer side and two coupling-spines on the inner. The rami are very little longer than the peduncle; the *outer ramus* is composed of 4 joints, the 1st nearly three times as long as the other three together, each joint provided with two long plumose setae; the *inner ramus* has 3 joints, the 1st four times the length of the other two together, two plumose setae to each joint, and one large cleft spine on the first.

UROPODA.—*Adult* (Pl. XXI. figs. 9, 10, 11, 13; *cf.* also fig. 14). The apices of the 1st uropods reach considerably beyond the peduncles of the 3rd; those of the 2nd and 3rd pairs are on a level.

The peduncle of the 1st uropod is broad and long, equal to the outer ramus in length, with one small seta on its outer margin, and ten large, strong spines on the inner edge. The rami are broadly lanceolate, curved, the outer being the shorter of the two. The inner ramus has both margins serrated, with three spines on the inner one; the outer ramus bears six minute sensory setules (fig. 11) deeply indented in its upper margin, the distal half of which is serrated, as is also the under margin.

The rami of the 2nd uropod are subequal, longer than the peduncle and slightly curved. The peduncle bears one small spine on the inner angle. The upper margin of the outer ramus is beset with five minute setules, no serrations, all the other margins finely serrated.

The peduncle of the 3rd uropod is short, wider than long, the rami twice its length, the outer one bi-articulate. The outer margins of both rami are plain, the inner edges serrated; the small 2nd joint of the outer ramus having 12 or 13 fine serrations.

For the *young*, see Pl. XXI. figs. 12, 15, 16. The outer margin of the outer ramus of the 1st and 2nd uropods is deeply notched near the apex. In this notch, set as it were in a little pocket, is a large sensory seta, similar to the sensory setule of the adult, but on a much larger scale (fig. 12).

TELSON.—*Adult* (Pl. XVII. fig. 13, Pl. XXI. fig. 17). Rounded anteriorly, narrowing posteriorly, longer than the peduncle of the 3rd uropod, and almost as broad as long. The apex is obtusely truncated, distinctly emarginate, tipped with two setules. It has four transverse rows of spinules dorsally, as described for *T. niceense*, and six of the tufted setules. (For arrangement and detail, see Pl. XVII. fig. 13; *cf.* fig. 11.)

In the *immature* (Pl. XXI. fig. 18) and *young* forms (fig. 15) the telson is incised for about one fifth of its length, with the apices rounded.

### III. GENERAL REMARKS.

The Norwegian form of this animal when first discovered was considered of sufficient importance to rank as one of the principal

divisions of the Amphipoda, the tribe *Prostomatæ* being established by Boeck for its reception.

Boeck noted many points of resemblance to the Lysianassidæ—the structure of the upper antennæ, the powerful hand of the first gnathopod, and the slender characteristic second gnathopod; but it remained for Sars to prove conclusively its relationship to that family, in which it now rests.

Boeck considered, and Bovallius and Sars are in agreement with his views, that the peculiar tubiform structure of the mouth indicates a parasitic habit. Most of the specimens have been taken on fish. The first were caught by Prof. Rasch by lowering in the trawl a freshly-killed and skinned bird, to the body of which they clung, sucking the blood. Herr Storm found it in the Thronhjemsfjord “parasite on a shark” (*Boeck*), as well as on the common black dogfish (*Sars*). Bovallius captured several specimens in the Harlangersfjord, “parasites on or in company with an *Asterias*.” Prof. Sars has taken it in the Thronhjemsfjord, in all cases clinging to the skin of the black dogfish (*Spinax niger*). Mr. Tattersall’s specimen, the only one yet recorded out of Norway, was taken in a small tow-net attached to the trawl.

The Mediterranean form also has always been recorded as taken on fish. The first specimens were found, as Costa states, on “squalo” and “merluzzi”; the three examined by Della Valle were taken on “merluzzi,” and the one recorded by Brian was discovered in the mouth of a “*Chlorophthalmus agassizi*.” On the other hand, Chevreux’s specimen from the Bay of Biscay, the ‘Huxley’ specimen from the north of the Bay of Biscay, and Mr. Tattersall’s six specimens from the West of Ireland, were all free-swimming. Mr. Stebbing’s S.-African species also appears to have been captured free-swimming.

It would seem better, all things considered, to describe this genus as predatory rather than parasitic. All the Lysianassidæ are carnivorous: in many of the genera they move in vast hordes devouring any carrion they find, and not hesitating to attack anything living unable to escape them, such as fish caught in a net. Many instances of this could be cited; to take an example from my own observation—in the Nassa-pots placed in Plymouth Sound by the Marine Laboratory I have found the common little *Orchomenella nanus* swarming in thousands, not only eating the dead crabs used for bait, but devouring the living polyps of the *Perigonimus* on the Nassa shells, and attacking the Nassa themselves whenever extruded. And again, in a dredging taken off the Eddystone, over 18,000 *Scopelocheirus hopei* were found in two Echinus-shells. A statement of Prof. Della Valle’s supports this view in regard to *T. niccense*; in the ‘Fauna’ (15), p. 287, he says, referring to his three specimens:—“Uno di questi individui portava ancora imprigionato nel formidabile organo di presa dei suoi gnatopodi posteriori un pezzo di carne del pesce su cui era attaccato.” (*Cf.* also Chevreux, 21.)

Two features render this genus noteworthy—the inflation of one

or more joints of the peraeopods and the peculiar torsion of the first gnathopod. This torsion is caused by the curvature of the fourth and fifth joints, by which the normal position of the hand and finger is reversed. Even in the young *T. raschii* taken from the incubatory pouch a slight curvature can be seen, and the immature specimen, 9 mm. in length, shows it already completed. All the adult specimens of *T. raschii* yet discovered are females, and all have this torsion. In *T. nicæense* some specimens show it and others not. Costa's specimens are figured with the hand normal; Della Valle records his three specimens, all males, with the torsion; Brian's specimen, ovigerous female, normal; Chevreux's, ovigerous female, with the hand twisted; while the 'Huxley' specimen is an ovigerous female, and normal. In the six taken by Mr. Tattersall, three males and three females, the way the hand is held can be plainly seen. The second joint of the first gnathopod is long and much curved; the third or elbow makes an acute bend forward; the fourth bends back towards the second; and the fifth turns a little forward and outwards in such a way as to hold the sixth joint or "hand" with its inner side uppermost, so that the claw and curved spines are on top, and the articulation of the claw appears to be in the infero-posterior angle instead of the infero-anterior angle as in the normal position. The "hand" is enormously inflated, and subquadrate. It is carried usually with the claw articulation outwards and a little raised, the tips of the claws meeting under the animal. All the joints are strengthened with ridges of chitin, and all their margins are remarkably strong and thick. The animal is evidently able to turn the hands in any direction at will; this can be plainly seen in Mr. Tattersall's specimens. In one or two both hands are normal; in one specimen one hand is normal and the other twisted, in the others the hands are in the position just described—these differences being evidently due to the animal's contortions when being preserved.

Another peculiarity of this genus is the inflation of one or more joints of the peraeopoda: in *T. raschii* the fourth joint of the first and second peraeopods; in *T. nicæense* the second joint of the first and second peraeopods; and in Mr. Stebbing's new species the sixth joint of the fifth peraeopod.

The sensory equipment of these animals is remarkable, there being no less than twenty-five specialised forms of setæ, four of which are peculiar to the antennæ, five to the oral parts, four to the second gnathopoda, one to the incubatory lamellæ, four to the pleopoda, and one to the telson. As the number and arrangement of the setæ appear constant, I have thought it well to give them in detail.

The chief differences in the three species hitherto known lie in the shape of the 2nd, 3rd, and 4th side-plates, the antennæ, the 2nd and 4th joints of the anterior peraeopods, the 2nd joints of the hinder peraeopods, and in the telson. In the adult *T. nicæense* the telson is entire; in *T. raschii* deeply incised in the young and

immature, and lightly excavated, almost entire, in the adult; in Mr. Stebbing's species, "perhaps not fully adult," deeply incised. The incision appears to be a character of the young, but this point cannot be settled till the young of *T. niceense* and the adult of the last species are known.

This genus is a deep-water form, not being recorded from less than 60 fathoms in northern seas, 30-40 fathoms in southern waters.

#### IV. DEFINITION OF GENUS.

##### Family Lysianassidæ.

Genus TRISCHIZOSTOMA Boeck & Esmark, 1860.

- 1853. *Guerinia* (preoccupied, 1830) A. Costa (1).
- 1860. *Trischizostoma* Boeck (3).
- 1865.     "     Lilljeborg (5).
- 1870.     "     Boeck (7).
- 1872.     "     Boeck (8).
- 1886.     "     Bovallius (11).
- 1888.     "     Stebbing (12).
- 1890.     "     G. O. Sars (13).
- 1893. *Trischizostoma* & *Guerina* Della Valle (15).
- 1895. *Trischizostoma* Stebbing (16).
- 1905. *Guerinella* Chevreux (18).
- 1906. *Trischizostoma* Stebbing (19).

*Body* thick, slightly compressed, rounded dorsally.

*Head* longer than first segment of pereon, with a short, anteriorly-rounded rostrum, produced over the bases of the superior antennæ.

*Eyes* very large, contiguous dorsally, occupying the whole surface of the head, except the rostrum and infero-lateral margin.

*Superior antenna*: peduncle very stout, with first joint larger than the other two; first joint of primary flagellum so large as to appear a continuation of the peduncle, thickly fringed with sensory filaments; accessory flagellum 3- or 4-articulate, with the first joint long and laminar.

*Inferior antenna* much longer than superior antenna; flagellum in male longer than in female.

*Oral parts* greatly projecting inferiorly.

*Mandibles* with large body carrying very large 3-articulate, densely setose palp; cutting-edge truncate, unarmed; no molar.

*Maxilla* 1: outer plate elongate, slightly contracted just below the apex, which is divided into 5 claw-like teeth; inner plate small, unarmed; palp small, bi-articulate.

*Maxillipeds* large, outer plates partly encompassing the oral parts; inner plates narrow; palp 4-articulate.

*Pereon*: last two segments smaller than preceding; infero-posterior angles of segments produced backwards and rounded.

*Side-plates*: 1st small, nearly triangular, almost completely

covered by the large second pair, which are dilated inferiorly; 5th and 6th inferiorly bilobed; 7th small, subquadrate.

*Branchial lamellæ* very large, much pleated.

*1st gnathopod* enormously developed, subchelate, prehensile.

*Pleon*: first 3 segments very large, rounded; the 4th with a deep depression dorsally; the 5th the shortest.

*Uropoda* with broadly lanceolate, serrate rami; outer ramus of 3rd uropod bi-articulate.

*Telson* small, broad, entire or apically incised.

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## EXPLANATION OF THE PLATES.

## PLATE XIV.

Fig. 1. The whole animal magnified, with line above showing actual length .....	<i>T. nicræense</i> .	
2. Cuticle, taken from underneath the rostrum, ♀ ...	"	× 265.
3. Superior antenna, ♀ 'Huxley' specimen (with tip of sensory filament × 265) .....	"	× 17.
4. Superior antenna, ♂ Irish specimen .....	"	× 17.
5. Accessory flagellum, superior antenna, ♂ .....	"	× 42.
6. Inferior antenna, ♀ 'Huxley' specimen .....	"	× 17.
7. " " ♂ Irish specimen .....	"	× 17.
8. Calceolus from inferior antenna ♂, the third from the tip .....	"	× 265.
9. Two auditory setæ from the 4th joint of the peduncle, inferior antenna, ♂ Irish specimen ...	"	× 265.
10. Upper lip, ♂ Irish specimen .....	"	× 42.
11. Lower lip flattened out, ♂ Irish specimen .....	"	× 42.
12. Right mandible, ♀ 'Huxley' specimen .....	"	× 42.
13. Cutting process, ♀ 'Huxley' specimen .....	"	× 75.
14. Left mandible, ♂ Irish specimen .....	"	× 42.

## PLATE XV.

Fig. 1. First maxilla, ♂ Irish specimen (with 4th spine × 265, to show the serration) .....	<i>T. nicæense.</i>	× 42.
2. First maxilla, ♂, magnified to show palp and inner plate .....	"	× 75.
3. Second maxilla, ♂ Irish specimen .....	"	× 42.
4. Maxilliped, ♂ Irish specimen .....	"	× 42.
5. Palp of maxilliped, inner surface, ♀ 'Huxley' specimen .....	"	× 42.
6. First gnathopod, ♂ Irish specimen .....	"	× 17.
7. " " ♀ 'Huxley' specimen .....	"	× 17.
8. " " inner surface, ♀ 'Huxley' spec- imen (with three of the small teeth from the palm × 75) .....	"	× 17.

## PLATE XVI.

Fig. 1. Second gnathopod, ♀ 'Huxley' specimen .....	<i>T. nicæense.</i>	× 17.
2. Claw of second gnathopod, ♂ Irish specimen .....	"	× 265.
3. Terminal joints of second gnathopod, ♀ 'Huxley' specimen .....	"	× 42.
4. Tip of "hyaline hair," 6th joint, second gnathopod, ♀ 'Huxley' specimen .....	"	× 265.
5. Tip of "jointed seta," 6th joint, second gnathopod, 'Huxley' specimen .....	"	× 265.
6. One of the "dactyloptera" of the 4th pereopod, ♀ 'Huxley' specimen .....	"	× 150.
7. First pereopod, ♀ 'Huxley' specimen .....	"	× 17.
8. Second " ♀ 'Huxley' specimen .....	"	× 17.
9. Third " ♀ 'Huxley' specimen .....	"	× 17.

## PLATE XVII.

Fig. 1. Fourth pereopod, ♀ 'Huxley' specimen .....	<i>T. nicæense.</i>	× 17.
2. Fifth " ♀ 'Huxley' specimen .....	"	× 17.
3. Fringe of spines on anterior angle of 5th joint, 5th pereopod, 'Huxley' specimen .....	"	× 265.
4. Second pleopod, 'Huxley' specimen .....	"	× 17.
5. Coupling spines, second pleopod, 'Huxley' spe- cimen .....	"	× 265.
6. Tip of uncinat seta, second pleopod, 'Huxley' specimen .....	"	× 265.
7. Tip of 5th cleft spine, second pleopod, 'Huxley' specimen .....	"	× 265.
8. Uropoda and telson, ♂ Mediterranean specimen .....	"	× 17.
9. Serrations, inner margin of inner ramus, first uropod, ♀ .....	"	× 265.
10. Serrations, inner margin of outer ramus, first uropod, ♀ .....	"	× 265.
11. Telson, ♂ Irish specimen .....	"	× 42.
12. Sensory setule from telson, Irish specimen .....	"	× about 500.
13. Telson, ♀ .....	<i>T. raschii.</i>	× 42.

## PLATE XVIII.

Fig. 1. First three segments of pleon, adult ♀ .....	<i>T. raschii.</i>	× 8.
2. Superior antenna, adult ♀ .....	"	× 17.
3. Terminal joints of accessory flagellum, superior antenna, ♀ .....	"	× 42.
4. Superior antenna, immature specimen .....	"	× 42.
5. " " young specimen .....	"	× 42.
6. Inferior antenna (seen from the under side), adult ♀ ..	"	× 17.
7. " " young specimen .....	"	× 42.
8. Oral parts in position, ♀ .....	"	× 17.
9. Upper lip, ♀ .....	"	× 17.
10. Lower lip with one lobe flattened, ♀ .....	"	× 17.

Fig. 11. Upper and lower lips, young specimen .....	<i>T. raschii.</i>	× 42.
12. Mandible, adult ♀ .....	"	× 42.
13. " young specimen .....	"	× 75.
14. First maxilla, adult ♀ .....	"	× 42.
15. Apex of the outer plate, first maxilla, adult ♀ .....	"	× 265.

## PLATE XIX.

Fig. 1. Apex of the outer plate, first maxilla, adult ♀.		
For comparison .....	<i>T. nicæense.</i>	× 265.
2. First maxilla, young specimen .....	<i>T. raschii.</i>	× 75.
3. Apex of the outer plate, first maxilla, young specimen .....	"	× 265.
4. Second maxilla, adult ♀ .....	"	× 42.
5. " young specimen .....	"	× 75.
6. Palp of maxilliped, right side, adult ♀ .....	"	× 42.
7. Maxillipeds, slightly flattened, seen from the under side, young specimen .....	"	× 75.
8. First gnathopod, showing the under surface, ♀ ...	"	× 17.
9. " " of immature specimen .....	"	× 17.
10. " " of a young specimen, taken from the incubatory pouch .....	"	× 42.
11. Second gnathopod, adult ♀ .....	"	× 17.

## PLATE XX.

Fig. 1. Claw of second gnathopod, adult ♀ .....	<i>T. raschii.</i>	× 150.
2. Tip of seta from the incubatory lamella, second gnathopod, ♀ .....	"	× 265.
3. One of the stiff setæ, distal margin, 6th joint, second gnathopod, ♀ .....	"	× 435.
4. Tip of "jointed seta," anterior angle, 6th joint, second gnathopod, ♀ .....	"	× about 500.
5. Tip of "hyaline hair," anterior angle, 6th joint, second gnathopod, ♀ .....	"	× about 500.
6. Second gnathopod, young specimen .....	"	× 42.
7. Claw of the second gnathopod, young specimen .....	"	× 265.
8. First pereopod, adult ♀, showing the branchial vesicle and the incubatory lamella .....	"	× 17.
9. First pereopod, young specimen .....	"	× 42.
10. Second pereopod, adult ♀ .....	"	× 17.
11. "Nail" of the 7th joint, 2nd pereopod, adult ♀ ...	"	× 265.

## PLATE XXI.

Fig. 1. Second pereopod, young specimen .....	<i>T. raschii.</i>	× 42.
2. Third pereopod, adult ♀ .....	"	× 17.
3. " " young specimen .....	"	× 42.
4. Fourth pereopod, adult ♀ .....	"	× 17.
5. " " young specimen .....	"	× 42.
6. Fifth pereopod, adult ♀ .....	"	× 17.
7. " " young specimen .....	"	× 42.
8. Tip of distal cleft spine, second pleopod, adult ♀ ...	"	× 265.
9. First uropod, adult ♀ .....	"	× 17.
10. Proximal spine, inner ramus, first uropod, adult ♀ ...	"	× 265.
11. Sensory setule, outer ramus, first uropod, adult ♀ ...	"	× 265.
12. " " " second uropod, young specimen .....	"	× 265.
13. Third uropod, adult ♀ .....	"	× 17.
14. " " For comparison .....	<i>T. nicæense.</i>	× 17.
15. Telson and uropoda, young specimen .....	<i>T. raschii.</i>	× 42.
16. Second joint, third uropod, young specimen .....	"	× 265.
17. Telson, adult ♀ .....	"	× 17.
18. " immature specimen .....	"	× 42.

#### 4. On certain Errors with reference to George the Fourth's Giraffe. By HENRY SCHERREN, F.Z.S.

[Received April 27, 1908.]

For more than seventy years the duration of life in captivity of the Giraffe presented to George IV. by the Pacha of Egypt has been considerably understated. The error undoubtedly originated in one of the Society's publications, and consequently has been widely copied. The following appears to be the earliest of the erroneous statements, and the source of all the rest :—

"In the year 1827 a female specimen in bad condition arrived at Windsor as a present to H.M. George IV. from the Pacha of Egypt. This individual, after lingering a few months, died, and its mounted skin and skeleton adorn the museum of the Society"\*.

This was repeated in the next List, the last of the series, published in 1844, whence it was copied into D. W. Mitchell's Guide, which appeared in 1852, with this addition :—"The animal died partly from bad management and partly from infirmity of constitution." In the edition of 1858 the supposed contributory causes are omitted, the statement being :—"It lived, however, only a few months at Windsor." This was repeated in the first edition of Dr. Sclater's Guide, published in 1859, and onwards in each successive publication down to the fifth edition of the Official Guide. It also occurs in a paper by Mr. Lydekker, F.R.S.†, on "Old Pictures of Giraffes and Zebras," in which it is stated that "the animal survived but a short time at Windsor," Dr. Graham's Renshaw‡ being quoted as the authority.

As a matter of fact, the animal lived at Windsor for two years and two months; and the evidence as to the dates of its arrival and death is here set out. At the end of 1826 the Giraffe was sent from Cairo to Malta, where it was kept over the winter. In May 1827 it was shipped in the 'Penelope' for London, with two Egyptian cows, in charge of two Arab keepers and an interpreter. These were landed at the Duchy of Lancaster Wharf, Waterloo Bridge, on the evening of Saturday, August 11th, 1827; and on Monday morning Cross took the Giraffe to Windsor in one of Richardson's caravans. The King "hastened to inspect his extraordinary acquisition, and was greatly pleased with the care which had been taken to bring it to his presence in fine order"§. The animal was referred to by the author of 'The Menageries' || (i. p. 343) as still living in June 1829; and in an article published in 1833, under the editorial supervision of Owen—if, indeed, it was not written by him,—it was said to "have increased eighteen

\* 'List of Animals in the Gardens,' p. 35 (1837).

† P. Z. S. 1904, ii. p. 339.

‡ 'Natural History Essays' (p. 105, 1904).

§ 'Literary Gazette,' Aug. 25, 1827, p. 554.

|| 'Library of Entertaining Knowledge.'

inches in less than two years"\*. In 1854 the true date was again indicated :

"The giraffe sent to the French menagerie did well; that presented at the same time to George IV. was the shortest and weakest. [The Consuls of each nation drew lots for the choice.] She was never in good health, and had been roughly treated, and though she had grown eighteen inches up to June 1829, she sank gradually and died in the autumn of that year"†.

By 1879 the correct date was given by Dr. Wilhelm Stricker :

"Ein zweites nach London bestimmtes Exemplar traf im August 1827 anderthalb Jahre alt, daselbst ein, verendete aber schon im Oktober 1829 ebenfalls an Gelenkkrankheit wahrscheinlich, weil es in Afrika auf weite Strecken geknebelt auf dem Rücken von Kameelen transportiert worden war"‡.

Major Fortuné Nott stated that the Giraffe "died in 1829"§ ; and while collecting material for my book on the history of the Society I was so fortunate as to meet with evidence that enabled me to fix the exact date of the animal's death.

A paragraph in the 'Times' of Oct. 19, 1829, taken from the 'Windsor Express' of Oct. 17, puts the actual date beyond doubt. It runs thus:—

"Messrs. Gould and Tomkins, of the Zoological Gardens, are now dissecting the giraffe which expired on Sunday last [Oct. 11]. We understand that when the skin is stuffed His Majesty intends making it a present to the Zoological Society."

So that the Giraffe lived exactly two years and two months in this country, having been landed in London on August 11, 1827.

At the meeting of Council held on August 28, 1830, Lord Auckland, President of the Society, submitted "an offer by Sir William Freemantle of the skin and skeleton of the giraffe that lately died at Windsor." It was resolved that the Secretary be requested to inform Sir W. Freemantle that they thankfully accept the same, and will also bear the charges of preserving and setting up the animal. In the second edition (1838) of the 'Catalogue of Mammalia in the Society's Museum,' the animal is entered as being "presented by His Majesty William IV."

Another error with regard to the animal is that it was well known to the people of the metropolis—a popular favourite. The writer of the article in the 'Zoological Magazine,' previously referred to, stated that, owing to the distance from town at which this animal was kept and the state of confinement which its weakly condition rendered indispensable during the latter part of its existence, the living Giraffe was seen in this country by comparatively few individuals.

In the paper by Mr. Lydekker already cited, the author, in describing a painting by R. B. Davis, then in the Royal Collection at Windsor, having on the back the note "Portrait of Giraffe belonging to His Majesty"||, suggested that the artist took "a

\* 'Zoological Magazine,' i. p. 3.

† 'English Cyclopædia' (Nat. Hist.), ii. col. 1028.

‡ 'Geschichte der Menagerien,' S. 25.

§ 'Wild Animals Photographed and Described,' p. 225.

|| P. Z. S. 1904, ii. p. 342 (text-figure).

portrait of the Cape Giraffe for his model, and he may have copied Paterson's specimen in the British Museum." It should, I think, be remembered that Richard Bennett Davis was an artist of good reputation. He was afterwards animal-painter to William IV., and the Court Officials of that day must have been aware of his presence for the express purpose of painting the Giraffe, and indeed of his whole history. He owed his education as an artist to royal favour. His father had been huntsman to the royal harriers; George III. took favourable notice of some of the boy's sketches, and placed him under Sir William Beechey. In 1806 he sent to the Academy a painting, "Mares and Foals from the Royal Stud at Windsor." His appointment as animal-painter to the King was made in 1831, and he painted the cavalcade which formed the coronation procession of that monarch\*.

There is, moreover, incontestable evidence that he did paint the Giraffe, and practically all that we know about the habits of the animal in captivity came from his pen. He contributed a very interesting account of the Giraffe to the 'Literary Gazette'†; and in the following passage occurs the first mention of the bilobed teeth known to me:—

"The upper lip is longer than the lower one, which assists the tongue in drawing in the boughs; but when grinding its food it is contracted. It has no teeth or nippers in the upper jaw, and the outside ones are divided to the socket. It is a ruminating animal, and lies down when it chews the cud."

The fact that Davis painted a picture of the Giraffe was stated by the editor of the 'Literary Gazette,' who expressed "our obligation for this paper to Mr. R. B. Davis, who, while painting the picture of the animal for His Majesty, had many opportunities of observing its peculiarities." In 'Menageries' (p. 348) Davis's account of the bilobed teeth is quoted, but this important part of his narrative is omitted from the 'Zoological Magazine' and the 'English Cyclopædia.'

## 5. On the Breeding-Habits of a Cichlid Fish (*Tilapia nilotica*).

By CHARLES L. BOULENGER, B.A., F.Z.S.

[Received March 23, 1908.]

During a short expedition in the spring of last year to Lake Qurun, in the Fayûm province of Egypt, I was able to make some observations on the breeding-habits of *Tilapia nilotica*, the "Bolti sultani" of the native fishermen.

These interesting Cichlids abound in the brackish waters of the lake and are extensively fished for by the natives, the Birket el Qurun supplying most of the markets of Lower Egypt with this excellent food-fish.

Isolated observations have been recorded on the habits of the

\* Dict. Nat. Biogr. xiv. p. 171.

† Dec. 1, 1829.

Bolti; but a complete account of the nesting-processes has never been published.

On visiting the fish-markets on the shores of the lake, and inspecting the baskets full of Boltis, the first thing to strike one is the fact that some individuals are more brilliantly coloured than others: these the natives declared to be males, the females being less vividly coloured. I accordingly dissected and sexed a few examples, and found this statement to be correct.

The males, which grow to a larger size than the females, have the whole of the ventral surface of the head and belly, almost as far back as the commencement of the anal fin, of a bright red colour; the throat is of a particularly brilliant hue. The pectoral and pelvic fins are bright red, and the top of the head also bears red pigment—not, however, so vivid as on the ventral side, and inclining rather to violet.

In the females, on the other hand, the red colour is absent from the top of the head and from the pectoral fins; the throat and belly are pink.

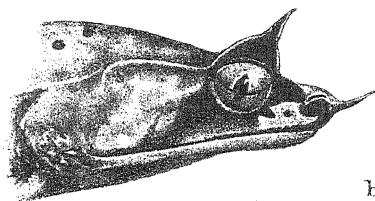
The brighter colours and the large size of the males render these easily distinguishable from the females, even when viewed in the water.

In common with many other Cichlid fishes, *Tilapia nilotica* excavates holes for breeding-purposes; these were first observed by Loat in Lake Menzaleh. In Lake Qurun these nests or, as the natives call them, "houses" of the Bolti are to be found close to the shore in two to three feet of water. I found them to occur almost exclusively on the north or desert side of the lake. The reason for this is, I think, quite evident to anyone familiar with the Birket el Qurun; for on this side the water becomes rapidly deeper offshore, enabling the fish when disturbed to dart off into deep water, where they are safe from their numerous enemies. On the south side of the lake the conditions are very different, there being often fifty yards of muddy shallows to cut off their retreat.

The nests are merely basin-shaped holes scooped out in the sand, usually among reeds or tamarisk bushes. The largest one I saw measured just over a yard in diameter and one and a half feet deep. I had the good fortune to be able to watch a Bolti at work on one of these nests. The latter was nearly completed when I commenced my observations at the beginning of May and was occupied by a large male with brilliantly coloured head and fins; there were no signs of a female in the neighbourhood. The male remained by himself in the nest during the two days that I observed him, and was occupied chiefly in smoothing down the sides of the excavation; this he did by revolving round and round with his tail in the centre, brushing away dirt from the sides of the nest with his fins. On the third day I returned early to the nest and found it unoccupied. A short distance away, however, the same male was to be seen now accompanied by a female; courtship was evidently in progress, the male swimming



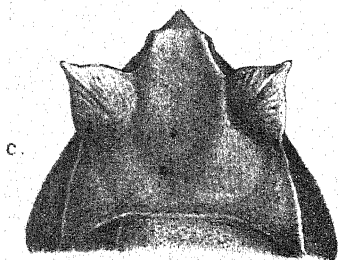




b.



a.



c.

MEGALOPHRYS NASUTA.

J. Green del. et lith.

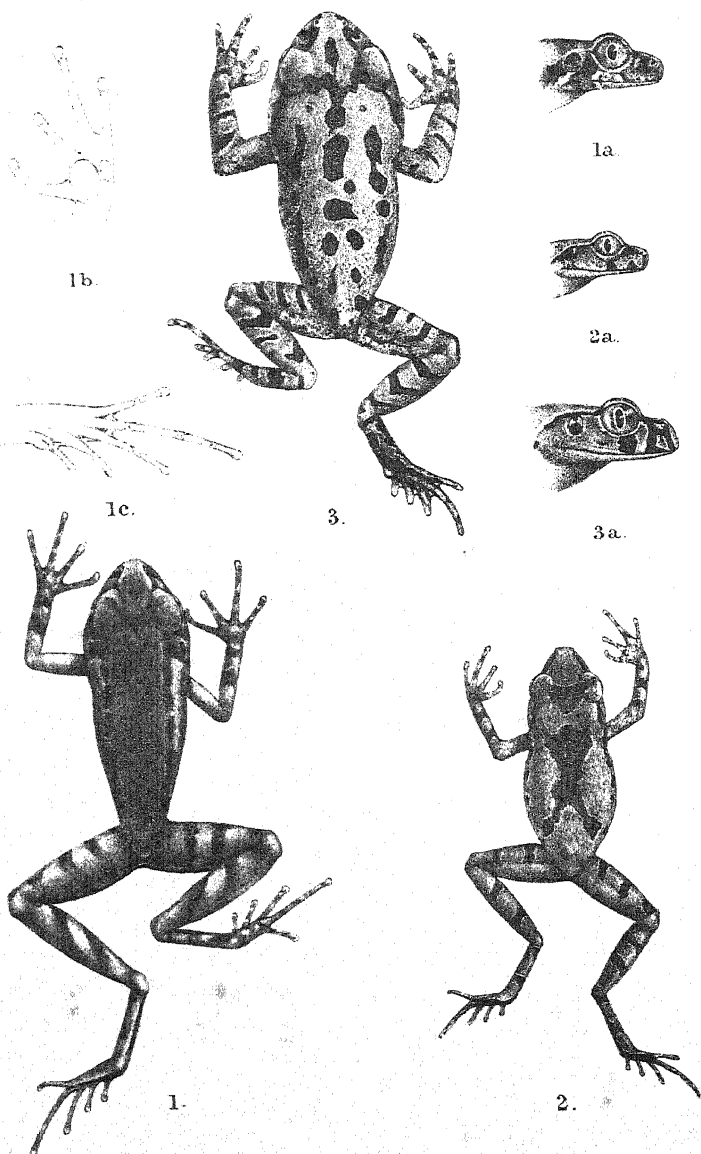




J. Green del et lith.

MEGALOPHRYS MAJOR.





J. Green. del. et lith.

1. MEGALOPHRYS GRACILIS. 2. M. HETEROPUS.  
3. M. HASSELTII.

about in front of the female, exhibiting his brilliantly coloured throat and fins to their best advantage.

During a short absence from my post of observation, the pair was disturbed by fishermen with casting-nets and never returned to the nest.

We see, however, that it is the male only who constructs the nest, and it is not until the latter is completely finished that he goes out in search of a mate. This is by no means unusual; and a similar state of things has been described in the American Cichlid, *Geophagus brasiliensis*, and in many Centrarchids.

The native fishermen confirmed my observations and informed me that they made use of their knowledge by catching the large males over the holes, the fish being too occupied by their nest-making to be easily disturbed.

I was unfortunately unable to witness the oviposition; but an intelligent native whom I cross-examined informed me that male and female repair together to the nest where the eggs are deposited, the female later taking them into her mouth. He ridiculed the idea of a reverse process of parturition, which Loat asserts to be the belief of some of the Nile fishermen.

A number of fish were brought to me containing ova or young in the mouth; these, as was to be expected\*, all proved to be females. One specimen, carrying young measuring about 10 mm. in length, had the oviducts full of large ripe eggs, and was evidently prepared to mate again as soon as the first brood was disposed of, as already ascertained by Pellegrin† in *Tilapia galilæa*.

## 6. A Revision of the Oriental Pelobatid Batrachians (Genus *Megalophrys*). By G. A. BOULENGER, F.R.S., V.P.Z.S.

[Received April 6, 1908.]

(Plates XXII.-XXV.‡ and Text-figure 78.)

My attention has been drawn to the generic characters of the Pelobatidæ of the Oriental Region through the notes published by Mr. Beddard a year ago in these 'Proceedings'§ on the anatomy of *Megalophrys nasuta*, in which he stated that the single specimen examined by him had procelous vertebræ, whereas the genus *Megalophrys* had been defined by Cope and myself as having the vertebræ opisthocelous. A skeleton of an adult *Megalophrys nasuta* which I had prepared confirmed Mr. Beddard's statement; but at the same time I find the vertebræ to be procelous also in some specimens of *M. montana*, the type of the genus, and of *M. longipes*, of which species other specimens

\* Cf. G. A. Boulenger, Tr. Zool. Soc. xvii. 1906, p. 538.

† Mém. Soc. Zool. France, xvi. 1904, p. 311.

‡ For explanation of the Plates, see p. 430.

§ P. Z. S. 1907, p. 324.

showed them to be opisthocœlous. It is therefore clear that the character, however important it may appear at first, is worthless even as a specific character in these Batrachians. I had to a certain extent foreseen this result in 1882\*, when I refused to divide these frogs into larger groups according to the mode of articulation of the vertebræ, as had been done by Cope† and Lataste‡, remarking that: "In this case, this character does not seem to me to be of such importance as was believed by some authors. It has been noticed that, in some individuals of various species, the intervertebral spheres do not become firmly attached to either centrum at maturity, and one adult specimen of *Xenophrys monticola* in the British Museum exhibits a very anomalous mode of articulation, the fourth vertebra being biconcave, the fifth biconvex, the others procœlian." Curiously, I was soon after censured by R. Blanchard§ for not having divided the Tailless Batrachians into two primary groups: the Opisthocœlous and the Procœlous.

Still I persisted in using the character of the opisthocœlous vertebræ for separating *Megalophrys* from *Leptobrachium*, with which I had been obliged to unite Günther's *Xenophrys* when it was shown that the presence or absence of vomerine teeth could not be used as a generic character in this group||. Now an unexpected discovery shows the last genus to be still more closely related to the first.

Some time ago, whilst collecting in Darjeeling, Dr. Annandale found some curious tadpoles agreeing so closely with those of *Megalophrys montana*, first described from Java by Prof. Max Weber and since found in the Malay Peninsula. However, owing to the fact that *M. montana* has never been recorded from the Himalayas, whilst *Xenophrys monticola* (now called *Megalophrys parva*) is common there, doubts arose in his mind as to the correctness of the identification, and he sent me a large series of specimens, adult and young, of the latter species, together with several specimens of the problematic larva, one of which has the limbs fully developed. A study of this material has convinced me that the so-called *Xenophrys monticola* has the same sort of tadpole as *Megalophrys montana*, so closely resembling it that I can only distinguish it by the whitish colour of the belly, which in the Malay species is dark brown. I have therefore no hesitation in abandoning the genera *Xenophrys* and *Leptobrachium* and uniting them with the first-described *Megalophrys*. And as the species are in want of revision, I have seized this opportunity for submitting them all to a renewed study, the results of which appear in this paper.

Before proceeding with the descriptions of the species, I wish to reply to two criticisms of Beddard's in the above-quoted paper.

\* Cat. Batr. Ecaud. p. 432.

† J. Acad. Philad. (2) vi. 1866, p. 67.

‡ Actes Soc. Linn. Bord. xxx. 1879, p. 330.

§ Bull. Soc. Zool. France, 1885, p. 584.—Reply by Boulenger, op. cit. 1886, p. 320.

|| Ann. Mus. Genova, (2) vii. 1889, p. 750.

First, he remarks that I am mistaken in describing *Megalophrys* as with "outer metatarsals united," in opposition to *Pelobates* with "outer metatarsals separated by web." He finds that "both frogs agree in the separation by web, only that the web is more extended towards the tip of the toes in *Pelobates*." The figure given by him of *Megalophrys* (fig. 92, p. 326) shows, however, that the web does not extend into the metatarsal part of the foot, the outer metatarsal segments being completely bound together by the integument; whilst in *Pelobates*, when spread out, they are seen to be separated by a deep groove into which the web penetrates, as in the true Frogs.

Secondly, Mr. Beddard still thinks the fusion of the coccyx with the sacral vertebra to be an important character in *Megalophrys nasuta*, although I have shown it to be variable in *Pelobates*. I find it to be likewise variable in *Megalophrys*, as may be seen from the following notes on various vertebral columns examined by me:—

In a dry skeleton of *M. montana* and in two smaller specimens in spirit of the same species, which I examined when preparing the 'Catalogue of Batrachians' published in 1882, I found the presacral vertebrae, 8 in number, opisthocœlous, and the coccyx articulating with the sacral vertebra by one condyle, as stated by Cope. In another skeleton, which has since been prepared, the vertebrae are proœlous, and the coccyx is likewise distinct from the sacral vertebra.

In a skeleton of a large *M. nasuta*, from Kina Balu, in which the dermal ossification forms a complete roof over the skull, similar to but thinner than that of *Pelobates cultripes*, and not extending over the temples, the vertebral column is as in the second specimen of *M. montana*, except that the coccyx is immovably fixed to the sacrum, although the line of separation is visible on the lower aspect. Exactly the same condition obtains in a large *M. major*. In a smaller specimen of *M. nasuta* from the same locality the coccyx is quite free from the sacral vertebra and the vertebrae are opisthocœlous.

The vertebrae are proœlous or opisthocœlous in *M. longipes*, and the coccyx is completely fused with the sacrum.

In several specimens of *M. parvus* the vertebrae are proœlous and the coccyx is free and movable.

A skeleton of *M. pelodytoides* is interesting as showing an anomaly somewhat similar to one described by Howes in *Bombinator*\*. Anomalies, we know, are frequent in the Discoglossidae and also in *Pelobates*†. There are two triangular

Text-fig. 78.



Vertebral column of *Megalophrys pelodytoides*, ventral aspect.

\* Proc. Anat. Soc. 1890, p. xvi, fig.

† Cf. Adolphi, Morphol. Jahrb. xx. 1895, p. 449, pl. xix.



sacral diapophyses on the left side—the first on the ninth vertebra, as normal, the second being part of the coccyx; on the right side the ninth vertebra has a slender diapophysis, as on that preceding it, and the triangular process forms part of the coccyx.

I have alluded above to irregularities in the mode of articulation of the vertebræ, which lose all systematic importance from the fact that, in these lowly forms, the intervertebral sphere of cartilage which is at first distinct from the so-called centra, as they ossify, become attached either to the vertebra anterior or posterior to each, if not remaining independent. We may thus find, on the same vertebral column, procœlous, opisthocœlous, or amphicœlous vertebræ; and it is now quite clear that such a character is worthless in the Pelobatidæ even as a specific character. I may add that the same will probably be found to be the case in the Hemiphractidæ. Brocchi has described the vertebræ of *Hemiphractus* as opisthocœlous. I have not been able to verify the statement, but I find them procœlous in a skeleton of the closely-allied *Ceratophyla bubalus*.

#### Genus MEGALOPHRYS Kuhl.

Pupil erect. Tongue circular or pyriform, entire or nicked and free behind. Vomerine teeth in two small groups, if present. Tympanum distinct or hidden under the skin. Fingers free, toes free or shortly webbed; outer metatarsals united. Sternum with a bony style. Coccyx, if distinct from the sacral vertebra, with simple articulation.

South-eastern Asia.

#### *Synopsis of the Species.*

I. Profile of snout obliquely truncate, strongly projecting beyond lower jaw; canthus rostralis angular and loreal region vertical or slightly oblique.

A. Head at least once and a half as broad as long (to occiput); tibio-tarsal articulation not reaching eye; vomerine teeth usually present; tympanum hidden or feebly distinct.

End of snout without or with a mere indication of a dermal appendage; outer border of upper eyelid produced in the adult into a pointed appendage, which does not, as a rule, measure more than half diameter of eye

1. *M. montana* Kuhl.

Snout terminating in a pointed dermal appendage; outer border of upper eyelid produced into a pointed appendage, which is at least  $\frac{2}{3}$  diameter of eye in the adult

2. *M. nasuta* Schleg.

B. Head not more than once and two-fifths as broad as long; tympanum distinct.

1. Tibio-tarsal articulation reaching beyond eye; vomerine teeth present.

Upper eyelid with a horn-like tubercle; tibia  $1\frac{1}{2}$  to  $1\frac{3}{4}$  times in length from snout to vent; toes with a slight rudiment of web

3. *M. longipes* Blgr.

Upper eyelid without appendage; tibia  $1\frac{3}{4}$  to 2 times in length from snout to vent; toes  $\frac{1}{2}$  to  $\frac{2}{3}$  webbed

4. *M. major* Blgr.

2. Tibio-tarsal articulation not reaching beyond eye (rarely slightly beyond); tibia at least twice in length from snout to vent; toes with a slight rudiment of web.
- Vomerine teeth present; tympanum about  $\frac{1}{2}$  diameter of eye, which equals the distance between the two ..... 5. *M. robusta* Blgr.
- Vomerine teeth present; tympanum  $\frac{2}{3}$  to  $\frac{3}{4}$  diameter of eye, which is less than the distance between the two... 6. *M. parva* Blgr.
- Vomerine teeth none; tympanum  $\frac{3}{4}$  to  $\frac{1}{2}$  diameter of eye, which is less than the distance between the two..... 7. *M. boettgeri* Blgr.
- II. Snout rounded or vertically truncate, not or but feebly projecting beyond lower jaw.
- A. Tibio-tarsal articulation reaching the eye, or beyond; head as long as broad or slightly broader than long; tympanum perfectly distinct; no vomerine teeth.
- Tibio-tarsal articulation reaching tip of snout; tibia a little more than  $\frac{1}{2}$  length from snout to vent; snout rounded ..... 8. *M. gracilis* Gthr.
- Tibio-tarsal articulation reaching eye; tibia  $\frac{1}{2}$  length from snout to vent; snout truncate ..... 9. *M. heteropus* Blgr.
- Tibio-tarsal articulation reaching eye or between eye and nostril; tibia  $\frac{1}{2}$ , or a little less than  $\frac{1}{2}$ , length from snout to vent; snout rounded..... 10. *M. pelodytoides* Blgr.
- B. Tibio-tarsal articulation not reaching the eye; tympanum feebly distinct or hidden.
1. Head not more than once and  $\frac{1}{2}$  as broad as long; no vomerine teeth; toes  $\frac{1}{4}$  to  $\frac{1}{2}$  webbed.
- Foot longer than head ..... 11. *M. bouleengeri* Bedr.
- Foot as long as head ..... 12. *M. hasseltii* Tsch.
2. Head at least once and  $\frac{3}{4}$  as broad as long; one or several conical tubercles on upper eyelid; vomerine teeth usually present.
- Loreal region very oblique; toes  $\frac{1}{4}$  to  $\frac{1}{2}$  webbed ..... 13. *M. carinensis* Blgr.
- Loreal region very oblique; toes nearly free or with a mere rudiment of web ..... 14. *M. fea* Blgr.
- Loreal region vertical; toes with a mere rudiment of web ..... 15. *M. balneensis* Blgr.

# 1. MEGALOPHRYS MONTANA.

*Megophrys monticola* Kuhl, Isis, 1822, p. 475.

*Megalophrys montana* Kuhl, in Férussac, Bull. Sc. Nat. ii. 1824, p. 83; Wagler, Syst. Amph. p. 204 (1830); Tschudi, Class. Batr. p. 82 (1838); Dum. & Bibr. Erp. Gén. viii. p. 458 (1841); Günth. Cat. Batr. Sal. p. 36 (1858), and Ann. & Mag. N. H. (4) xi. 1873, p. 419; Bouleng. Cat. Batr. Ecaud. p. 442 (1882); M. Weber, Ann. Jard. Bot. Buitenzorg, xv. Suppl. ii. 1898, p. 5; Laidlaw, Proc. Zool. Soc. 1900, p. 889; Annandale, Fasc. Mal., Zool. ii. p. 275 (1903).

*Ceratophrys montana* Gravenh. Delic. Mus. Zool. Vratisl. p. 47 (1829); Schleg. Abbild. p. 29, pl. x. fig. 3 (1837).

*Ceratophryne montana* Schleg. Handl. Dierk. ii. p. 57 (1858).

*Megalophrys montana*, part., Günth. Rept. Brit. Ind. p. 413 (1864).

*Megalophrys montana*, var. *aceras*, Bouleng. in Annandale & Robins. Fasc. Mal., Zool. p. 131, pl. v. fig. 1 (1903).

Tongue entire or feebly nicked behind. Vomerine teeth usually present, in two widely separated small groups just behind the level of the choanæ. Head large,  $1\frac{1}{2}$  to  $1\frac{3}{4}$  times as

broad as long, usually defined behind by a more or less distinct transverse fold; snout truncate or obtusely pointed, projecting beyond lower jaw, as long as or a little shorter than eye; canthus rostralis sharp; loreal region vertical or a little oblique, concave; nostril equally distant from eye and from end of snout; interorbital space concave, its width  $1\frac{1}{2}$  to 2 times that of upper eyelid (narrower in the very young); tympanum usually feebly distinct, rarely hidden, its diameter  $\frac{1}{2}$  to  $\frac{2}{3}$  that of eye, from which it is separated by a distance equal to the diameter of the latter. Fingers obtuse or feebly swollen at the end, first as long as or a little longer than second, which measures  $\frac{2}{3}$  to  $\frac{3}{4}$  length of third; no subarticular tubercles; no distinct metacarpal tubercles. Toes rather short, obtuse or feebly swollen at the end, with a mere rudiment of web or, at most,  $\frac{1}{4}$  webbed; no subarticular tubercles; a flat, very indistinct inner metatarsal tubercle. Tibio-tarsal articulation reaching the shoulder, the commissure of the jaws, or the temple; tibia  $\frac{3}{8}$  to  $\frac{1}{2}$  length from snout to vent; foot as long as or shorter than tibia. Skin of upper parts smooth or with scattered conical warts, old specimens with bony deposits on the head and anterior part of the back; a strong glandular fold from eye to shoulder, usually another on each side of the back; upper eyelid with a sharp, raised edge, which is produced into a more or less distinct point or "horn"; this point may be very indistinct (var. *aceras* Blgr.), or very much developed, measuring nearly  $\frac{2}{3}$  diameter of eye; as a rule it does not measure more than  $\frac{1}{2}$  diameter of eye; an indication of a similar appendage on the tip of the snout rarely present\*; a more or less developed pointed tubercle usually present behind the commissure of the jaws; limbs usually with oblique transverse glandular ridges; throat smooth, belly with small tubercles. Olive-brown above, uniform or variously marked with darker or lighter; a more or less distinct large triangular dark spot between the eyes, the base forwards, and a dark oblique bar below the eye; limbs with more or less distinct dark cross-bars; lower parts pale brown, spotted or marbled with darker; a white tubercle on each side of the breast. Male without vocal sac.

Measurements of specimens from Java :—

	♂.	♀.
From snout to vent .....	55	88 millim.
Length of head (to occiput) .....	19	27 "
Width of head.....	29	43 "
Length of snout .....	6	8 "
Diameter of eye .....	6	8 "
Interorbital width .....	10	14 "
Diameter of tympanum .....	4	4 "
Distance between eye and tympanum ...	6	9 "
Fore limb.....	35	53 "
Hand .....	16	23 "
Hind limb .....	70	110 "
Tibia.....	23	35 "
Foot .....	21	35 "

\* In a specimen from Java, where the species is most abundant.

Originally described from Java, this curious-looking frog has since been found in other parts of the Malay Archipelago and in the Malay Peninsula. The numerous specimens in the British Museum are from Java, Borneo, Palawan, Balabac, Samar and Dinagat Ids. (Philippines), Sumatra, and Bukit Besar in Jalor.

It is a sluggish and thoroughly nocturnal animal. Nothing has been observed concerning its breeding-habits; but I find the eggs to be large, those in the oviduct of a specimen 83 millim. long measuring 3 millim. in diameter. The larvæ were first described by Max Weber\* from Java, and Laidlaw† and Annandale‡ have published observations on specimens obtained in the Malay Peninsula. These tadpoles are found in mountain-streams with gravelly beds and are remarkable for the funnel-like float formed by the lips, which are beset with minute horny teeth; these are not connected in any way with definite ridges or lamellæ, but radiate along the anterior surface of the funnel. According to Annandale, the funnel-shaped lip is capable of assuming two very distinct forms, according to the position of the tadpole:—(1) When the animal is hanging from the surface-film, as it frequently does, this structure becomes a translucent rhomboidal or lozenge-shaped float, depressed in the centre towards the mouth, but otherwise nearly flat; (2) when, on the other hand, the animal is resting on the bottom, the float takes on the appearance of a pair of slender processes, continued upwards on the sides, like a pair of horns. As in other Pelobatidæ, the spiraculum is sinistral. The tail is more than twice as long as the body, the total length of the largest tadpole being about 40 millim. The coloration is of a very dark brown, even on the belly.

## 2. MEGALOPHRYS NASUTA. (Plate XXII.)

*Ceratophrys montana*, var., Schleg. Abbild. p. 30 (1837).

*Megalophrys montana* (non Kuhl), Cantor, Cat. Mal. Rept. p. 140 (1847).

*Ceratophryne nasuta* Schleg. Handl. Dierk. ii. p. 57, pl. iv. fig. 72 (1858); Günth. Cat. Batr. Sal. p. 36 (1858).

*Megalophrys montana*, part., Günth. Rept. Brit. Ind. p. 413 (1864).

*Megalophrys chysii* Edeling, Tijdschr. Nederl. Dierk. 1864, p. 205, and Nat. Tijdschr. Nederl. Ind. xxvii. 1864, p. 265, pl. —.

*Ceratophrys nasuta* Schleg. Dierentuin, Rept. p. 58, fig. (1872).

*Megalophrys nasuta* Günth. Ann. & Mag. N. H. (4) xi. 1873, p. 419; Bouleng. Cat. Batr. Ecaud. p. 443 (1882); S. Flower, Proc. Zool. Soc. 1899, p. 913; Werner, Zool. Jahrb., Syst. xiii. 1900, p. 498; Isenschmid, Mitth. Nat. Ges. Bern, 1903, p. 21; Beddard, Proc. Zool. Soc. 1907, p. 324, figs.

Tongue entire or feebly nicked behind. Vomerine teeth present, in two widely separated small groups on a level with the posterior border of the choanæ. Head large,  $1\frac{1}{2}$  to 2 times as broad

\* Ann. Jard. Botan. Buitenzorg, 1898, Suppl. ii. p. 5.

† Proc. Zool. Soc. 1900, p. 889.

‡ Fascic. Malay., Zool. p. 275 (1903).

as long, usually defined behind by a more or less distinct transverse fold; snout truncate in profile, pointed from above, and projecting beyond lower jaw, as long as or a little shorter than eye; canthus rostralis sharp; loreal region vertical or a little oblique, concave; nostril equally distant from eye and from end of snout; interorbital space concave, its width  $1\frac{1}{2}$  to 2 times that of upper eyelid (narrower in the very young); tympanum often hidden; if distinct, its diameter  $\frac{1}{2}$  to  $\frac{2}{3}$  that of eye, from which it is widely separated. Fingers obtuse or feebly swollen at the end, first as long as or a little longer than second, which measures  $\frac{2}{3}$  to  $\frac{3}{4}$  length of third; no subarticular tubercles; no distinct metacarpal tubercles. Toes rather short, obtuse or feebly swollen at the end, with a mere rudiment or web or, at most,  $\frac{1}{4}$  webbed\*; no subarticular tubercles; a flat, very indistinct inner metatarsal tubercle. Tibio-tarsal articulation reaching the shoulder or the commissure of the jaws†; tibia  $\frac{1}{3}$  to  $\frac{2}{3}$  length from snout to vent; foot a little shorter than tibia. Skin of upper parts smooth or with a few scattered warts; adult with bony deposits on the head and anterior part of the back, which may completely fuse with the skull, and form a bony shield on the præsacral part of the body; a glandular fold from eye to shoulder, sometimes continued on the side of the body; another fold usually present higher up on the back, from behind the head to the sacral region; frequently, but not constantly, a subconical tubercle on the scapular region and another in the middle of the sacral region; similar tubercles, exceptionally, on the head; upper eyelid with a sharp, raised edge, produced into a long point or "horn," which is at least  $\frac{2}{3}$ , and often quite, as long as the eye in the adult; a similar, but shorter appendage on the end of the snout, and a still smaller one at the angle of the jaws; limbs with or without oblique transverse glandular ridges; lower parts smooth, or belly with small tubercles. Olive-brown above, uniform or variously marked with darker and lighter; a more or less distinct Y-shaped dark marking between the eyes and on the occiput; a dark oblique bar below the eye; lower parts dark brown, or spotted or marbled with dark brown. Male with an internal vocal sac.

Measurements of two specimens from Sumatra, found pairing by Dr. H. O. Forbes:—

	♂.	♀.
From snout to vent .....	82	125 millim.
Length of head (to occiput) .....	24	36   "
Width of head .....	41	60   "
Length of snout .....	8	12   "
Diameter of eye .....	7	11   "
Interorbital width .....	13	20   "
Diameter of tympanum .....	4	6   "
Distance between eye and tympanum ...	8	16   "

\* Isenschmid (*l. c.*) describes a specimen from Sumatra in which the toes are nearly half webbed.

† The eye in a specimen from Sumatra, according to Isenschmid (*l. c.*).

	♂.	♀.
Fore limb.....	54	74 millim.
Hand .....	20	31 ..
Hind limb .....	96	134 ..
Tibia.....	30	42 ..
Foot .....	29	40 ..

Known from the Malay Peninsula (Penang, Perak), Sumatra, Borneo, and the Natuna Islands.

The above description is almost a repetition of that of *M. montana*, so closely are these species allied to each other. As I mentioned in 1882, the only important difference between the two resides in the greater length of the palpebral horn-like appendage, and the presence of a similar appendage on the tip of the snout in *M. nasuta*. To this may be added the somewhat more anterior position of the vomerine teeth in *M. nasuta*.

Dr. H. O. Forbes has observed the frog to pair, in Sumatra\*, on the banks of streams, the male embracing the female round the lumbar region. Recently transformed young, some with remains of the larval tail, measuring 15 to 17 millim. from snout to vent, were obtained in Penang by Capt. Flower; the palpebral and rostral appendages are absent in three very young specimens, and I do not see how they can be distinguished from *M. montana* at a similar stage of development.

### 3. MEGALOPHRYS LONGIPES.

*Megalophrys longipes* Bouleng. Proc. Zool. Soc. 1885, p. 850, pl. lv.; Günth. Ann. & Mag. N. H. (5) xx. 1887, p. 316; A. L. Butler, Journ. Bombay N. H. Soc. xv. 1904, p. 400.

Tongue feebly nicked behind. Vomerine teeth in two small groups just behind the level of the choanæ. Head moderate, much depressed, once and  $\frac{1}{4}$  as broad as long; snout obliquely truncate in profile, projecting beyond lower jaw, nearly as long as eye; canthus rostralis sharp; loreal region vertical, concave; nostril equally distant from eye and from end of snout; inter-orbital space concave, as broad as or a little broader than upper eyelid; tympanum distinct,  $\frac{3}{5}$  to  $\frac{2}{3}$  diameter of eye, its diameter equal to or less than its distance from eye. Fingers slender, feebly swollen at the end, first as long as or a little longer than second, which measures about  $\frac{2}{3}$  length of third; no subarticular tubercles; no distinct metacarpal tubercles. Toes long and slender, feebly swollen at the end, with a slight rudiment of web; no subarticular tubercles; no distinct metatarsal tubercle. Tibio-tarsal articulation reaching beyond tip of snout, knee reaching axil or shoulder; tibia  $\frac{2}{3}$  to  $\frac{3}{4}$  length from snout to vent; foot shorter than tibia. Skin smooth above, with small warts on the flanks, and two pairs of delicate glandular folds originating on the scapular region and converging posteriorly, the outer extending to the sacral region; a strong fold from the eye to the shoulder; a

\* 'A Naturalist's Wanderings in the Eastern Archipelago' (London, 1885), p. 154. Proc. Zool. Soc.—1908, No. XXVII.

short horn-like tubercle on outer edge of upper eyelid; lower parts smooth. Olive-brown above; sides of head with oblique dark bars; a large triangular dark marking between the eyes; limbs with dark cross-bars; hinder side of thighs dark brown, with one or two round whitish spots; belly dotted or spotted with brown; throat and breast dark brown, or with large dark brown spots or symmetrical markings. Male with an internal vocal sac.

	♂.	♀.
From snout to vent.....	47	65 millim.
Length of head (to occiput) .....	14	19 "
Width of head.....	17	23 "
Length of snout .....	4	6 "
Diameter of eye .....	5	6 "
Interorbital width .....	5	8 "
Diameter of tympanum .....	3	3½ "
Distance between eye and tympanum ...	4	6 "
Fore limb.....	31	43 "
Hand .....	12	16 "
Hind limb .....	83	118 "
Tibia.....	27	38 "
Foot .....	22	33 "

Only known from the mountains of Perak, in the Malay Peninsula, between 3000 and 4500 feet. Mr. A. L. Butler has observed it to be the commonest frog on the hills above 3000 ft. and to be entirely nocturnal, being found in the daytime under logs, rocks, or in holes in banks, and in densely shaded spots among dead leaves. These frogs appear to be quite bewildered by the sunlight, and when disturbed give one jump into the open and make no other attempt to escape. When seized in the hand they frequently open their mouths widely for some seconds. Mr. Butler has never seen this frog enter water of its own accord, and he suspects very large ova ( $\frac{1}{2}$  inch in diameter), containing tadpoles with the hind limbs and tail well developed, which he found under damp moss on tree-trunks, to belong to it.

#### 4. MEGALOPHRYS MAJOR, n. n. (Plate XXIII.)

*Xenophrys gigas* Jerdon, Proc. As. Soc. Beng. 1870, p. 85, and in Anders. Proc. Zool. Soc. 1871, p. 200.

*Xenophrys monticola*, part., Anders. l. c.; Bouleng. Cat. Batr. Ecaud. p. 441 (1882).

? *Ixalus lateralis* Anders. Journ. As. Soc. Beng. xl. 1878, p. 29, and Anat. Zool. Res. Yunnan, p. 844, pl. lxxviii. fig. 5 (1879).

*Leptobrachium monticola*, part., Bouleng. Ann. Mus. Genova, (2) vii. 1889, p. 720, Faun. Ind., Rept. p. 510 (1890), and Ann. Mus. Genova, (2) xiii. 1893, p. 344.

Tongue entire or feebly nicked behind. Vomerine teeth in two small groups on a line with the posterior border of the choanae. Head moderate, more strongly depressed than in the preceding

species,  $1\frac{1}{4}$  to  $1\frac{2}{3}$  times as broad as long; snout obliquely truncate in profile, projecting beyond lower jaw, nearly as long as the eye; canthus rostralis sharp; loreal region vertical or slightly oblique, concave; nostril equally distant from eye and from end of snout; interorbital space flat or slightly concave, as broad as or a little broader than upper eyelid; tympanum more or less distinct, about half diameter of eye, the distance between eye and tympanum nearly equal to  $\frac{2}{3}$  or once the diameter of the former. Fingers with feebly swollen tips, first as long as or a little shorter than second, which measures about  $\frac{2}{3}$  length of third; no sub-articular tubercles; no distinct metacarpal tubercles. Toes moderate, with swollen tips,  $\frac{1}{4}$  to  $\frac{1}{3}$  webbed, the web extending as a lateral fringe; no subarticular tubercles; metatarsal tubercle flat, indistinct. Tibio-tarsal articulation reaching the tip of the snout or a little beyond, rarely only to between eye and nostril; tibia a little more than  $\frac{1}{2}$  or  $\frac{2}{3}$  (rarely only  $\frac{1}{2}$ ) length from snout to vent; foot considerably shorter than tibia. Skin smooth, or with fine granular asperities on the back; fine glandular ridges may be present on the body and across the limbs, one on each side of the back being constant and a V-shaped one behind the head very frequent; a glandular fold from the eye to the shoulder. Brown above, with darker, light-edged symmetrical markings, the most constant being a triangular spot between the eyes; a dark band capping the end of the snout as far as the nostrils and extending along the loreal and temporal regions to the shoulders; a light streak along the upper lip, sometimes interrupted by a dark brown bar below the eye; limbs with irregular dark cross-bands; hinder side of thighs dark brown, with a round white spot, which is nearer the leg than the vent; belly whitish, throat and breast brown or marbled with brown, with darker, light-edged spots on the lower lip, the last of which extends as a curved band to the anterior face of the arm. Male with a subgular vocal sac and fine brown nuptial asperities on the inner side of the first and second fingers.

Measurements of type specimens from Darjeeling:—

	♂.	♀.
From snout to vent.....	77	94 millim.
Length of head (to occiput) .....	22	25 "
Width of head.....	29	36 "
Length of snout .....	9	10 "
Diameter of eye .....	9	10 "
Interorbital width .....	8	10 "
Diameter of tympanum .....	4	5 "
Distance between eye and tympanum ...	7	9 "
Fore limb.....	48	59 "
Hand .....	21	26 "
Hind limb .....	127	162 "
Tibia.....	41	51 "
Foot .....	37	45 "
		27*



This frog was indicated, rather than described, by Jerdon in 1870, from specimens collected by him at Darjeeling and in the Khasi Hills, now preserved in the British and Indian Museums. Further allusion to it was made soon after by J. Anderson, who regarded it however as the adult of Günther's *Xenophrys monticola*. After examining about 50 specimens, measuring 32-94 millim. from snout to vent, I am convinced that Jerdon was right. Most of the specimens in the Indian Museum are from Cherrapunji, Khasi Hills. I have examined specimens from the Karin Hills, in Upper Burma, and from the Man Son Mts., Tonkin (3000-4000 feet). If I am right in regarding Anderson's *Ixalus lateralis* as a young *M. gigas*, the range of the species extends to Western Yunnan.

I regret the name chosen by Jerdon cannot be used for this species, as there is an earlier *Megalophrys gigas* Blyth, 1854, which is, however, a synonym of *Rana liebighii* Gthr. I have therefore proposed the new name *Megalophrys major*.

##### 5. MEGALOPHRYS ROBUSTA, sp. n. (Plate XXIV.)

Tongue feebly nicked behind. Vomerine teeth in two small groups on a line with or just behind the posterior borders of the choanæ. Head moderate, once and  $\frac{2}{5}$  as broad as long; snout obliquely truncate in profile, projecting beyond lower jaw, as long as eye; canthus rostralis sharp; loreal region slightly oblique, concave; nostril equally distant from eye and from end of snout, or slightly nearer the former; interorbital space concave, broader than upper eyelid; tympanum distinct, about half diameter of eye, which equals the distance between the two. Fingers with feebly swollen tips, first as long as or a little longer than second, which measures about  $\frac{2}{3}$  length of third; no subarticular tubercles; no distinct metacarpal tubercles. Toes moderately long, with feebly swollen tips, with a very slight rudiment of web; no subarticular tubercles; metatarsal tubercle flat, indistinct. Tibio-tarsal articulation reaching the eye, or between eye and nostril; tibia  $\frac{1}{2}$  or a little less than  $\frac{1}{2}$  length from snout to vent; foot a little shorter than tibia. Skin of upper parts smooth or finely granulate; a fine glandular ridge on each side of the back and a V-shaped one behind the head; a strong glandular fold from the eye to the shoulder. Brown above; a triangular dark marking between the eyes; a dark temporal band and a dark vertical bar below the eye; other dark bars sometimes present on the upper lip; hind limbs with indistinct dark cross-bars; hinder side of thighs dark brown, with a round light spot nearer the leg than the vent; belly white; throat and breast spotted or marbled with brown.

Measurements of two specimens in the Indian Museum, Calcutta:—

	♀.	Hgr.
From snout to vent .....	114	54 millim.
Length of head (to occiput) .....	30	15   ,,

	♀.	Hgr.
Width of head.....	43	21 millim.
Length of snout .....	10	5 ..
Diameter of eye .....	10	5 ..
Interorbital width .....	13	6 ..
Diameter of tympanum .....	4	2½ ..
Distance between eye and tympanum ...	10	5 ..
Fore limb.....	66	36 ..
Hand .....	27	14 ..
Hind limb .....	165	85 ..
Tibia.....	53	27 ..
Foot .....	49	25 ..

I have examined five specimens, all from Darjeeling, collected by Dr. J. Gammie, and preserved in the Calcutta Museum. I have been allowed to retain one (here figured) for the British Museum.

#### 6. MEGALOPHRYS PARVA.

*Xenophrys monticola* Günth. Rept. Brit. Ind. p. 414, pl. xxvi. fig. H (1864).

*Xenophrys monticola*, part., Anders. Proc. Zool. Soc. 1871, p. 200; Bouleng. Cat. Batr. Ecaud. p. 441 (1882).

*Leptobrachium monticola*, part., Bouleng. Ann. Mus. Genova, (2) vii. 1889, p. 720, and Faun. Ind., Rept. p. 510 (1890).

*Leptobrachium parvum* Bouleng. Ann. Mus. Genova, (2) xiii. 1893, p. 344, pl. xi. fig. 2.

Tongue entire or feebly nicked behind. Vomerine teeth in two small groups on a line with or just behind the posterior borders of the choanæ. Head moderate,  $1\frac{1}{4}$  to  $1\frac{1}{3}$  times as broad as long; snout obliquely truncate in profile, projecting beyond lower jaw, nearly as long as eye; canthus rostralis sharp; loreal region vertical, concave; nostril equally distant from eye and from end of snout; interorbital space flat, as broad as upper eyelid; tympanum more or less distinct,  $\frac{2}{5}$  to  $\frac{2}{3}$  diameter of eye, the distance between the two less than the diameter of the latter. Fingers with feebly swollen tips, first as long as or a little shorter than second, which measures about  $\frac{2}{3}$  length of third; no subarticular tubercles; no distinct metacarpal tubercles. Toes rather short, with feebly swollen tips, with a slight rudiment of web, often with a feeble dermal ridge on the lower surface, but without subarticular tubercles; metatarsal tubercle flat, indistinct. Tibiotarsal articulation reaching the eye or not quite so far; tibia  $\frac{1}{2}$  or a little less than  $\frac{1}{2}$  length from snout to vent; foot shorter than tibia. Skin of upper parts smooth or granular, with small glandular warts which may form symmetrical ridges, very variable in arrangement; a strong glandular fold from the eye to the shoulder; lower parts perfectly smooth. Brownish above, with more or less distinct darker symmetrical markings, the most constant of which forms a triangle or a Y between the eyes; some of the warts edged with blackish; upper lip with vertical dark

bars; limbs with more or less regular dark cross-bars; hinder side of thighs marbled with brown, usually with a round light spot nearer the leg than the vent; lower parts whitish, throat and breast spotted or marbled with brown, or with brown symmetrical marking; a round white spot often present on each side of the breast. Male with a subgular vocal sac, and with fine brown nuptial rugosities on the first and second fingers.

	♂.	♀.
From snout to vent.....	42	52 millim.
Length of head (to occiput) .....	11	15 "
Width of head .....	14	19 "
Length of snout .....	4	5 "
Diameter of eye .....	4½	6 "
Interorbital width .....	4	5 "
Diameter of tympanum .....	3	4 "
Distance between eye and tympanum ...	3	4 "
Fore limb .....	29	35 "
Hand .....	11	13 "
Hind limb .....	65	73 "
Tibia.....	21	24 "
Foot .....	18	20 "

The type specimens of *Xenophrys monticola*\*, in the British Museum, are from the Sikkin Himalayas and the Khasi Hills. Others, from Darjeeling (*Jerdon*) and Pegu (*Theobald*), are preserved in the same Institution. I have examined about 40 specimens from Darjeeling and Cherrapunji belonging to the Calcutta Museum. *Leptobrachium parvum* was described from specimens obtained by Fea in the Karin Hills, Upper Burma.

No direct observations have been made on the habits of this species, but an inspection of the oviducts of females on the point of spawning show the eggs to be large, 2 millim. in diameter. Tadpoles obtained by Dr. Annandale at Kurseong and referred by him provisionally to *M. montana* of Kuhl† belong, I feel convinced, to this species, in which the toes are nearly free. These tadpoles, with funnel-shaped mouth, agree very closely with those of the former species, as known from specimens obtained by Messrs. Annandale and Robinson in the Malay Peninsula, differing only, so far as I can see, in the whitish belly.

#### 7. MEGALOPHRYS BOETTGERI.

*Leptobrachium boettgeri*, Bouleng. Proc. Zool. Soc. 1899, p. 171, pl. xix. fig. 3.

Tongue entire. Vomerine teeth absent. Head moderate,  $1\frac{1}{5}$  to  $1\frac{1}{3}$  times as broad as long; snout obliquely truncate in profile, projecting beyond lower jaw, nearly as long as eye; canthus

\* The specific name of which must be changed, as being preoccupied in the genus *Megalophrys*.

† Proc. As. Soc. Beng. (2) ii. 1906, p. 290.

rostralis sharp; loreal region vertical, concave; nostril equally distant from eye and from end of snout; interorbital space flat, as broad as upper eyelid; tympanum very distinct,  $\frac{2}{3}$  to  $\frac{3}{4}$  diameter of eye, equal to or greater than its distance from latter. Fingers with feebly swollen tips, first and second equal, about  $\frac{2}{3}$  length of third; subarticular and carpal tubercles indistinct or absent. Toes slender, with feebly swollen tips, with a slight rudiment of web, often with a feeble dermal ridge on the lower surface, but without subarticular tubercles; a small, oval, flat inner metatarsal tubercle. Tibio-tarsal articulation reaching the eye; tibia  $\frac{1}{2}$  or a little less than  $\frac{1}{2}$  length from snout to vent; foot shorter than tibia. Skin smooth, with small scattered warts on the head and back; a glandular fold from the eye to the shoulder; two small white warts close together on the chin and one on each side of the breast near the insertion of the fore limb. Dark grey or brown above, with symmetrical blackish markings; upper surface of snout and scapular region light; a whitish blotch on the upper lip below anterior half of eye; limbs with dark cross-bands; a small round white spot on the back of the thigh; throat and breast brown or brownish; three longitudinal, blackish, light-edged markings on the throat; large blackish spots on the side of the belly; posterior part of belly and lower surface of thighs dirty white. Male with internal vocal sac.

	♂.	♀.
From snout to vent .....	35	46 millim.
Length of head (to occiput) .....	11	12 "
Width of head .....	13	15 "
Length of snout .....	3	4 "
Diameter of eye .....	4	5 "
Interorbital width .....	$3\frac{1}{2}$	5 "
Diameter of tympanum .....	$2\frac{1}{2}$	$3\frac{1}{2}$ "
Distance between eye and tympanum ...	$2\frac{1}{2}$	3 "
Fore limb .....	24	29 "
Hand .....	10	12 "
Hind limb .....	54	64 "
Tibia .....	17	22 "
Foot.....	15	19 "

Described from six specimens obtained by Mr. J. D. La Touche at Kuatun, N.W. Fokien, China. A specimen from Kiukiang has been noticed by Boettger (Ber. Senck. Ges. 1894, p. 141) under the name of *Leptobrachium monticola*.

#### 8. MEGALOPHRYS GRACILIS. (Plate XXV. fig. 1.)

*Leptobrachium gracile* Günth. Proc. Zool. Soc. 1872, p. 598; Bouleng. Cat. Batr. Ecaud. p. 440 (1882).

Tongue nicked behind. Vomerine teeth absent. Head moderate, as long as broad or slightly broader than long; snout rounded, not projecting beyond lower jaw, as long as or slightly shorter than orbit; canthus rostralis distinct; loreal region not

very oblique, concave; nostril a little nearer end of snout than eye; interorbital space a little narrower than upper eyelid; tympanum distinct, its diameter  $\frac{1}{2}$  that of eye, from which it is separated by a space nearly equal to its own diameter. Fingers slightly swollen at the end, first and second equal and about  $\frac{2}{3}$  length of third; no subarticular tubercles; two metacarpal tubercles, inner very large, outer small. Toes rather long and slender, with blunt or slightly swollen tips, with a very short web at the base; no subarticular tubercles, but a more or less distinct dermal ridge along the lower surface; a feebly prominent, elliptical inner metatarsal tubercle. Tibio-tarsal articulation reaching tip of snout; tibia a little more than  $\frac{1}{2}$  length from snout to vent; foot shorter than tibia, but longer than head. Skin smooth; a curved glandular fold above tympanum. Greyish olive to dark olive above, with more or less distinct darker spots or symmetrical markings on the head and body and cross-bars on the limbs; the type specimen has a whitish spot below the eye, and the upper arm and elbow whitish; lower parts dirty white, with or without irregular brown spots. Male unknown.

Measurements of ♀ (type specimen):—

From snout to vent .....	44 millim.
Length of head (to occiput).....	15 "
Width of head .....	16 "
Length of snout .....	5 "
Diameter of eye .....	5 "
Interorbital width .....	4 "
Diameter of tympanum .....	$2\frac{1}{2}$ "
Distance between eye and tympanum...	$2\frac{1}{2}$ "
Fore limb .....	33 "
Hand .....	12 "
Hind limb .....	71 "
Tibia .....	23 "
Foot .....	19 "

Young specimens with remains of the larval tail measure as much as 30 millim., whilst a female ready to spawn measures only 41. The eggs in the oviduct are very large and comparatively few, the diameter of the vitellus being 2 millim.

Founded on a single specimen from Matang, Borneo, this species has since been found on Mount Kina Balu, Borneo, and at Gumong Tahan, Pahang, in the Malay Peninsula, at an altitude of 5200 feet.

#### 9. MEGALOPHRYS HETEROPUS. (Plate XXV. fig. 2.)

*Leptobrachium heteropus* Bouleng. Ann. & Mag. N. H. (7) vi. 1900, p. 186.

Tongue nicked behind. Vomerine teeth absent. Head moderate, as long as broad; snout truncate at the end, not projecting beyond lower jaw, a little shorter than orbit; canthus

rostralis strong; loreal region not very oblique, concave; nostril a little nearer end of snout than eye; interorbital space as broad as upper eyelid; tympanum distinct, its diameter  $\frac{1}{2}$  that of eye, from which it is separated by a space equal to its own diameter. Fingers blunt, first and second equal and about  $\frac{2}{3}$  length of third; no subarticular tubercles; two metacarpal tubercles, inner very large, outer small. Toes moderately long, blunt, webbed at the base only, the web continued as a slight fringe along each side; a strong dermal ridge or keel along the lower surface of the third and fourth toes; a small, feebly prominent, oval inner metatarsal tubercle. Tibio-tarsal articulation reaching eye; tibia  $\frac{1}{2}$  length from snout to vent; foot shorter than tibia, but longer than head. Skin smooth, with small tubercles on the upper eyelids. Grey above, with darker light-edged symmetrical markings, the largest occupying the middle of the back; a black lumbar spot; a black canthal and temporal streak; black spots on the sides; dark cross-bars on the limbs; lower parts grey, speckled with black; a round whitish spot on each side of the breast, at the base of the arm, another on the back of each thigh.

Measurements of the single (♀) specimen:—

From snout to vent .....	33 millim.
Length of head (to occiput) .....	11 ..
Width of head .....	11 ..
Length of snout.....	4 ..
Diameter of eye.....	4 ..
Interorbital width.....	3 ..
Diameter of tympanum .....	2 ..
Distance between eye and tympanum...	2 ..
Fore limb .....	22 ..
Hand .....	8 ..
Hind limb .....	48 ..
Tibia .....	16 ..
Foot .....	13 ..

A single specimen from the Larut Hills, Perak, 3500 ft., formerly in the Selangor Museum, is now in the British Museum.

#### 10. MEGALOPHRYS PELODYTOIDES.

*Leptobrachium pelodytoides* Bouleng. Ann. Mus. Genova, (2) xiii. 1893, p. 345, pl. xi. fig. 3.

Tongue notched behind. Vomerine teeth absent. Head moderate, as long as broad or a little broader than long; snout rounded, scarcely projecting beyond lower jaw, a little shorter than orbit; canthus rostralis distinct; loreal region oblique, concave; nostril equally distant from eye and from end of snout; interorbital space as broad as upper eyelid; tympanum distinct, its diameter  $\frac{1}{2}$  or  $\frac{2}{3}$  that of eye, from which it is separated by a space equal or inferior to its own diameter. Fingers with slightly swollen tips, first and second equal and about  $\frac{2}{3}$  length of third;

no subarticular tubercles; two metacarpal tubercles, inner large, outer small. Toes moderately long, with slightly swollen tips, one-third webbed or less, the web extending as a fringe along each side, and with a more or less distinct dermal ridge along the lower surface; a small, feebly prominent, oval inner metatarsal tubercle. Tibio-tarsal articulation reaching eye, or between eye and nostril; tibia  $\frac{1}{2}$ , or a little less than  $\frac{1}{2}$ , length from snout to vent, as long as or slightly longer than foot. Upper parts with small smooth warts, lower smooth. Olive above, with dark spots, marblings, or symmetrical markings, which may be edged with lighter; upper lip with dark vertical bars; limbs with dark cross-bars; sometimes a round, white, dark-edged spot on back of thighs, nearer tibia than vent; white beneath, throat of male brown. Male with an internal subgular vocal sac.

The largest type specimen measures 37 millim. from snout to vent. The following are the measurements of an adult male from Burma (one of the types) and of a female from Tonkin in the British Museum:—

	♂.	♀.
From snout to vent .....	30	42 millim.
Length of head (to occiput) .....	10	14 "
Width of head.....	10	15 "
Length of snout .....	$3\frac{1}{2}$	5 "
Diameter of eye .....	$3\frac{1}{2}$	5 "
Interorbital width .....	3	4 "
Diameter of tympanum .....	2	3 "
Distance between eye and tympanum ...	$1\frac{1}{2}$	2 "
Fore limb .....	19	26 "
Hand .....	8	11 "
Hind limb .....	46	57 "
Tibia .....	15	19 "
Foot .....	15	18 "

This species was discovered in the Karin or Karennee Hills, east of Toungoo, between Burma and Siam, by the late L. Fea. The types were obtained at Thao (1300–1400 m.) and in the district of the Karin Bia-po. I refer to this species a number of specimens from a collection made in the Man-Son Mountains (3000–4000 feet) in Tonkin, on the Kwangsi frontier. These specimens differ from the types only in having the web between the toes less developed, being reduced to a rudiment in females, whilst none of the male specimens can be said to have them more than one-fourth webbed. Yet these specimens were procured during the breeding-season, the abdomen of the female being distended with very large ova (diameter of vitelline sphere 2 millim.). In all other respects, however, the resemblance with the typical *M. pelodytoides* is so great that I cannot adopt any other course than to regard them as specifically identical, a course which is fully justified by the amount of variation in this character exemplified by *M. hasseltii*.

## 11. MEGALOPHRYS BOULENGERI.

*Leptobrachium bouleengeri* Bedriaga, Przewalski Exped., Amph. p. 63, pl. i. fig. 7 (1898).

Tongue entire behind. Vomerine teeth absent. Head moderate, little broader than long; snout rounded, scarcely projecting beyond lower jaw, about as long as orbit; canthus rostralis distinct; loreal region oblique, feebly concave; nostril nearly equally distant from end of snout and from eye; interorbital space a little broader than upper eyelid; tympanum hidden. Fingers obtuse, not swollen at the end, first and second equal; no distinct subarticular tubercles; two moderately large carpal tubercles. Toes rather short, blunt, half-webbed, the web existing as a fringe to the tips; no distinct subarticular tubercles; inner metatarsal tubercles small, oval, feebly prominent. Tibio-tarsal articulation reaching the temple; tibia about  $\frac{1}{3}$  length from snout to vent; foot longer than head. Upper parts warty, the warts of unequal size; a strong glandular fold from eye to shoulder; lower parts smooth, except posterior part of belly, which is granulate. Light greenish grey above, with an ill-defined olive-brown vertebral band which expands into two branches between the eyes; some of the larger warts also olive-brown; a dark canthal and temporal streak; lower parts yellowish.

From snout to vent .....	49 millim.
Length of head .....	14 "
Width of head .....	15 "
Length of snout.....	6 "
Diameter of eye.....	$4\frac{3}{4}$ "
Interorbital width .....	4 "
Fore limb .....	29 "
Hind limb .....	58 "
Tibia .....	16 "
Foot.....	19 "

Dy-Chu River, Upper Yangtse Kiang, China.—Types in St. Petersburg Museum.

## 12. MEGALOPHRYS HASSELTHI. (Plate XXV. fig. 3.)

*Leptobrachium hasseltii* Tschudi, Class. Batr. p. 81 (1838); Günth. Cat. Batr. Sal. p. 36 (1858); Bouleng. Cat. Batr. Ecaud. p. 441 (1882), Zool. Rec. 1885, Rept. p. 24, Proc. Zool. Soc. 1890, p. 37, and Faun. Ind., Rept. p. 511 (1890); Isenschmid, Mitth. Nat. Ges. Bern, 1903, p. 20; Van Kampen, Zool. Jahrb., Syst. xxii. 1905, p. 712.

*Rana hasseltii* Schleg. Handl. Dierk. ii. p. 56, pl. iv. fig. 71 (1858).

*Leptobrachium montanum* Fischer, Arch. f. Nat. li. 1885, p. 44.

Tongue nicked behind. Vomerine teeth absent. Head large, about once and  $\frac{1}{4}$  as broad as long; snout rounded, not projecting beyond lower jaw, about as long as orbit; canthus rostralis



distinct; loreal region very oblique, concave; nostril a little nearer end of snout than eye; interorbital space a little broader than upper eyelid; tympanum hidden or feebly distinct, its diameter  $\frac{1}{2}$  to  $\frac{2}{3}$  that of eye, from which it is separated by a space less than its own diameter. Fingers obtuse, not swollen at the end, first and second equal or first the longer, third nearly twice as long as second; subarticular tubercles, if distinct, irregular in their disposition; two moderately large carpal tubercles, inner a little larger than outer. Toes short, obtuse, like the fingers, webbed at the base in females,  $\frac{1}{4}$  to  $\frac{1}{2}$  webbed in males; third toe not reaching beyond base of antepenultimate phalanx of fourth; subarticular tubercles sometimes distinct, sometimes more or less confluent into an obtuse ridge; inner metatarsal tubercle small, oval, feebly prominent. Tibio-tarsal articulation reaching the shoulder; tibia  $\frac{1}{2}$  to  $\frac{2}{3}$  length from snout to vent; foot as long as head. Skin smooth or with small tubercles above, granular on belly; a glandular fold from eye to shoulder. Brown, grey, or pale olive above, with small or large dark brown spots or marblings, which may be irregular or form a symmetrical pattern; a more or less distinct dark canthal and temporal streak; sides of snout with dark vertical bars; limbs with dark cross-bars; throat and belly dirty white, or brown speckled with white. Male with an internal vocal sac.

	♂.	♀.
From snout to vent .....	47	74 millim.
Length of head (to occiput) .....	16	23 "
Width of head.....	20	31 "
Length of snout .....	6	10 "
Diameter of eye .....	5	9 "
Interorbital width .....	6	10 "
Diameter of tympanum .....	3	6 "
Distance between eye and tympanum ...	2	4 "
Fore limb.....	33	50 "
Hand .....	11	16 "
Hind limb .....	53	79 "
Tibia.....	16	24 "
Foot .....	15	23 "

Burma, Malay Peninsula, Sumatra, Borneo, Palawan, Java.

The larva has been first noticed by me, from specimens from Sumatra and Perak, and others have since been obtained in Selangor by Mr. Butler, and in Perak by Dr. Hanitsch. These tadpoles are of the same type as the typical *Pelobatids* of Europe, but remarkable in being marked all over with numerous deep black dots or round spots. No observations have been made on the breeding-habits, but it is probable that the eggs are laid in the water, being similar to those of *Pelobates*. Eggs from the oviducts of a female 65 millim. long measure 2 millim. in diameter.

Mr. A. L. Butler observes (*Journ. Bombay N. H. Soc.* xv. 1904, p. 397) that the larval period of existence is very prolonged, and

that the tail does not disappear until the size of about 40 millim. (from snout to vent) is attained.

### 13. MEGALOPHRYS CARINENSIS.

*Leptobrachium carinense* Bouleng. Ann. Mus. Genova, (2) vii. 1889, p. 748, and Faun. Ind., Rept. p. 511 (1890); W. Schlater, Proc. Zool. Soc. 1892, p. 347; Bouleng. Ann. Mus. Genova, (2) xiii. 1893, p. 345, pl. xii.

Tongue very indistinctly nicked behind. Vomerine teeth absent or in two widely separated small groups between the large choanae \*. Head very large and externally depressed, once and  $\frac{3}{4}$  to twice as broad as long; snout rounded, as long as eye or orbit, not projecting beyond lower jaw; canthus rostralis distinct; loreal region very oblique, slightly concave; nostril equally distant from eye and from end of snout; interorbital space nearly twice as broad as upper eyelid; tympanum completely hidden. Fingers short, blunt or with slightly swollen tips, first and second equal, about  $\frac{2}{3}$  length of third; no subarticular tubercles; metacarpal tubercles indistinct. Toes short, blunt or with slightly swollen tips,  $\frac{1}{4}$  to  $\frac{1}{2}$  webbed, the web extending as a slight fringe on each side; no subarticular tubercles; a very large, oval, flat inner metatarsal tubercle. Tibio-tarsal articulation reaching axil or shoulder in female, commissure of jaws in males; tibia  $\frac{1}{3}$  to  $\frac{2}{5}$  length from snout to vent; foot longer than head. Skin with bony deposits on head and anterior part of body; a strong transverse fold defines the head behind; a strong glandular fold from eye to shoulder; upper eyelid with conical tubercles, two to four of which may be enlarged and form very short "horns"; body with small scattered smooth warts, which are larger and may be conical on the sides; an oblique glandular fold, parallel with the supratemporal fold, on each side of back, as far as sacral region; more or less distinct oblique glandular folds across the limbs; throat finely granulate, belly nearly smooth. Upper surface of head and sides of body yellowish; back between the dermal ridges purplish grey (brown in spirit); eyes, dermal ridges, and larger tubercles bordered with black; some of the lateral tubercles pure white; limbs purplish grey; gular region brown or purplish black; belly brown or whitish. Male with an internal vocal sac.

	♂.	♀.
From snout to vent .....	123	150 millim.
Length of head (to occiput) .....	33	37 "
Width of head.....	58	70 "
Length of snout .....	12	12 "
Diameter of eye .....	10	12 "

\* The palate was toothless in the specimen originally described. Vomerine teeth were subsequently found, by Mr. W. Schlater and by myself, in other specimens. That the character is not of specific importance in this case is further evidenced by the fact that a large female specimen from Fea's collection has a group of vomerine teeth on the left side and no trace of them on the right side.

	♂.	♀.
Interorbital width .....	17	22 millim.
Fore limb.....	66	72 „
Hand .....	28	34 „
Hind limb .....	137	160 „
Tibia.....	45	51 „
Foot .....	44	53 „

Several specimens were obtained by the late L. Fea on the western slope of the Karin or Karennee Hills, east of Toungoo, Burma, at an altitude of 2500 feet or upwards. The species has been recorded from Mergui, Tenasserim, by W. L. Schlater. According to Fea, the males show themselves very irritable when disturbed, opening their wide gape, ready to bite at the slightest provocation, emitting at the same time a shrill cry. The female is of more gentle disposition. The strong jaws of this frog enable it to overpower small mammals, and a large female contained, in addition to insects, a small squirrel.

#### 14. MEGALOPHRYS FEE.

*Megalophrys fee* Bouleng. Ann. Mus. Genova, (2) iv. 1887, p. 512, and v. 1887, p. 423, pl. v.

*Leptobrachium fee* Bouleng. op. cit. vii. 1889, p. 750, and Faun. Ind., Rept. p. 512 (1890).

Tongue feebly nicked behind. Vomerine teeth usually present, in two widely separated small groups just behind level of choanæ. Head very large and extremely depressed, once and  $\frac{3}{4}$  to twice as broad as long; snout rounded, hardly as long as eye, not projecting beyond lower jaw; canthus rostralis distinct; loreal region very oblique, slightly concave; nostril equally distant from eye and from end of snout; interorbital space slightly concave, twice as broad as upper eyelid; tympanum completely hidden. Fingers short, blunt, first and second equal,  $\frac{2}{3}$  length of third; no subarticular tubercles; metacarpal tubercles indistinct. Toes short, blunt, nearly free or with a mere rudiment of web at the base; no subarticular tubercles; a very large, oval, flat inner metatarsal tubercle. Tibio-tarsal articulation reaching axil, shoulder, or commissure of jaws; tibia  $\frac{1}{3}$  to  $\frac{2}{3}$  length from snout to vent; foot longer than head. Skin with bony deposits on head and anterior part of body; a strong transverse fold defines the head behind; a strong glandular fold from eye to shoulder; upper eyelid with tubercles, one of which is larger and conical and may be developed into a rather long horn-like appendage in the adult. Body and limbs above with scattered small smooth warts; no longitudinal glandular folds; lower parts smooth. Olive-brown above; a T- or Y-shaped darker marking on the head, the transverse branch between the eyes, often dividing the head into a lighter anterior and a darker posterior portion; a dark temporal band, the lip below it yellowish; lips, eyes, and some of the larger warts on the body edged with blackish; some of the warts whitish;

lower parts dirty white to dark brown; throat sometimes spotted with dark brown. Male with an internal vocal sac.

The type specimen, a female, measures 110 millim. from snout to vent.

Measurements of specimens in the British Museum:—

	♂.	♀.
From snout to vent .....	82	106 millim.
Length of head (to occiput) .....	25	31 ..
Width of head.....	46	57 ..
Length of snout .....	8	10 ..
Diameter of eye .....	9	10 ..
Interorbital width .....	13	16 ..
Fore limb.....	45	55 ..
Hand .....	24	28 ..
Hind limb .....	98	130 ..
Tibia.....	31	39 ..
Foot.....	31	41 ..

*M. fea* was discovered by the late L. Fea in the Kakhven Hills, east of Bhamo, Upper Burma. But the species extends further east, as the British Museum possesses a specimen obtained by Hr. Frulstorfer in the Man-Son Mountains, Tonkin (altitude 3000–4000 feet); this specimen, in which the supraocular “horn” is very feebly developed and vomerine teeth are absent, I had first referred to *L. carinense* (Ann. & Mag. N. H. (7) xii. 1903, p. 186).

#### 15. MEGALOPHRYS BALUENSIS.

*Leptobrachium baluense* Bouleng. Ann. & Mag. N. H. (7) iv. 1899, p. 453, and Journ. Str. Br. As. Soc. xxxiv. 1900, pl. ii. fig. 1.

Tongue entire. Vomerine teeth in two widely separated small groups just behind level of choanae. Head moderately large, much depressed, nearly twice as broad as long; skin adherent to the rugose skull; snout rounded, much shorter than orbit, not projecting beyond lower jaw; canthus rostralis strong; loreal region vertical, concave; nostril equally distant from eye and from end of snout; interorbital space slightly concave, nearly twice as broad as upper eyelid; tympanum feebly distinct,  $\frac{2}{3}$  diameter of eye, about  $\frac{1}{2}$  its distance from eye. Fingers rather elongate, slender, blunt, first a little longer than second, which is  $\frac{2}{3}$  length of third; no subarticular tubercles; no metacarpal tubercles. Toes moderately long, slender, blunt, with a mere rudiment of web; no subarticular tubercles, but a feeble median ridge or keel under the toes; a very indistinct oval inner metatarsal tubercle. Tibiotarsal articulation reaching shoulder; tibia  $\frac{2}{3}$  length from snout to vent; foot much longer than head. Skin perfectly smooth; a very small conical tubercle near the border of the upper eyelid, above the pupil. Back and upper surface of snout dark grey;

posterior half of upper surface and sides of head blackish brown; a curved light streak, the concavity turned forwards, across upper eyelids and interorbital region, followed by a Y-shaped blackish marking; two light spots on upper lip, below eye; large blackish-brown partly confluent spots on the back; sides dark brown, light-edged above; limbs dark brown, with rather indistinct darker cross-bars; throat brown, belly brownish white.

From snout to vent .....	65 millim.
Length of head (to occiput).....	16 "
Width of head .....	28 "
Length of snout .....	4 "
Diameter of eye .....	6 "
Interorbital width .....	10 "
Diameter of tympanum .....	3½ "
Distance between eye and tympanum...	7 "
Fore limb .....	40 "
Hand .....	18 "
Hind limb .....	85 "
Tibia .....	27 "
Foot .....	27 "

Known from a single female specimen, full of ripe eggs 3 millim. in diameter, discovered by Dr. Hanitsch on Mount Kina Balu, Borneo, at an altitude of 4200 feet.

#### EXPLANATION OF THE PLATES.

##### PLATE XXII.

- a.* *Megalophrys nasuta*, p. 411. Brunei, Borneo.  
*b.* Side view of head of *a.*  
*c.* Head of specimen from Penang.

##### PLATE XXIII.

- Megalophrys major*, p. 416. Type.  
 With side view of head.

##### PLATE XXIV.

- Megalophrys robusta*, p. 418. Type.  
 With side view of head.

##### PLATE XXV.

- Fig. 1. *Megalophrys gracilis*, p. 421. Type.  
 1 *a.* Side view of head.  
 1 *b.* Lower view of hand,  $\times 2$ .  
 1 *c.* " " foot,  $\times 2$ .  
 Fig. 2. *Megalophrys heteropus*, p. 422. Type.  
 2 *a.* Side view of head.  
 Fig. 3. *Megalophrys hasseltii*, p. 425. Java.  
 3 *a.* Side view of head.

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THE END.



ABSTRACT OF THE PROCEEDINGS  
OF THE  
ZOOLOGICAL SOCIETY OF LONDON.\*

January 14th, 1908.

Prof. J. ROSE BRADFORD, M.D., D.Sc., F.R.S., Vice-President,  
in the Chair.

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The SECRETARY read a report on the additions that had been made to the Society's Menagerie during the month of December 1907.

Mr. W. P. PYCRAFT, F.Z.S., exhibited, on behalf of Mr. R. LYDEKKER, F.R.S., F.Z.S., an abnormally marked Leopard-skin from the Deccan, India, which had been presented to the British Museum of Natural History by Mr. F. A. Coleridi.

Dr. W. A. CUNNINGTON gave an account of an expedition conducted last spring, in conjunction with Mr. C. L. Boulenger, to investigate the flora and fauna of the Birket el Qurun—the lake Moeris of the ancients. The expedition was undertaken on behalf of the Egyptian Survey Department, and one important result was the discovery of a new lacustrine medusa.

Mr. OLDFIELD THOMAS read a paper, the sixth of the series, on mammals obtained in the Shantung Peninsula, N China, by Mr. M. P. Anderson, for the Duke of Bedford's exploration of Eastern Asia. No mammals had come from this region since the time of Consul Swinhoe, who had visited it in 1866-68. The present series contained 106 specimens belonging to six species, of which one was new.

Mr. F. E. BEDDARD, F.R.S., Prosector to the Society, read a communication entitled "On the Musculature and other Points in the Anatomy of the Engystomatid Frog, *Breviceps verrucosus*."

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\* This Abstract is published by the Society at 3 Hanover Square, London, W., on the Tuesday following the date of Meeting to which it refers. It will be issued, free of extra charge, to all Fellows who subscribe to the Publications, along with the 'Proceedings'; but it may be obtained on the day of publication at the price of *Sixpence*, or, if desired, sent post-free for the sum of *Six Shillings* per annum, payable in advance.

Mr. C. L. BOULENGER, B.A., gave an account of a communication entitled "On the Hermaphroditism of the Amphipod *Orchestia deshayesii*, Audouin."

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The next Meeting of the Society for Scientific Business will be held on Tuesday, the 4th February, 1908, at half-past Eight o'clock P.M., when the following communications will be made:—

1. F. MARTIN DUNCAN.—Cinematograph demonstration of results of Natural Colour Photography with Zoological Subjects.

2. O. THOMAS.—The Duke of Bedford's Zoological Exploration in Eastern Asia.—VII. List of Mammals from the Tsu-shima Islands.

3. T. GOODEY.—On the Presence of Gonadial Grooves in *Aurelia aurita*.

4. C. TATE REGAN.—The Duke of Bedford's Zoological Exploration in Eastern Asia.—VIII. A Collection of Freshwater Fishes from Corea.

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Communications intended for the Scientific Meetings of the ZOOLOGICAL SOCIETY OF LONDON should be addressed to

P. CHALMERS MITCHELL, *Secretary*.

3 HANOVER SQUARE, LONDON, W.

January 21st, 1908.

ABSTRACT OF THE PROCEEDINGS  
OF THE  
ZOOLOGICAL SOCIETY OF LONDON.\*

February 4th, 1908.

H.G. THE DUKE OF BEDFORD, K.G., President, in the Chair.

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Mr. F. MARTIN DUNCAN gave a lantern exhibition of the Lumière Autochrome Natural Colour Process as applied to zoological subjects.

Mr. OLDFIELD THOMAS, F.R.S., read a paper, the seventh of the series, on Mammals from the Islands of Tsu-shima, between Korea and Japan, collected by Mr. Malcolm P. Anderson in carrying out the Duke of Bedford's Exploration of Eastern Asia. So far as its mammals were concerned, the Tsu-shima group was shown to be predominantly Japanese in character, though three of its species were distinctly Korean, but these, Mr. Thomas thought, might possibly have been accidentally introduced from the mainland. Twelve species were recorded from the Islands, and, including a few which came from other sources, 151 specimens were dealt with.

Mr. T. GOODEY read a paper "On the Presence of Gonadial Grooves in *Aurelia aurita*," of which the following is an abstract:—"The 'gonadial grooves' are seen in a view of the sub-umbrella surface, and lie in the four interradial axes. Each has about the same diameter as the origin of an ordinary per-radial or ad-radial canal, and extends from the central gastric cavity into a gastric pouch, ending there in a slight expansion. The groove is confined to the ventral wall or floor, and is formed by a folding of the endodermal epithelium. It is suggested that the grooves function

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as channels for the outward conveyance of the ripe sex-cells when liberated from the gonads. The Ctenophor *Ctenoplana* is the only other Cœlenterate possessing genital ducts, but it is only in the Scyphozoon *Aurelia* that the structures can be regarded as celomic or archenteric derivations."

Mr. C. TATE REGAN, M.A., F.Z.S., read a paper entitled "The Duke of Bedford's Zoological Exploration of Eastern Asia.—VIII. A collection of Freshwater Fishes from Corea." The collection included examples of eleven species, seven of which were described as new to science.

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The next Meeting of the Society for Scientific Business will be held on Tuesday, the 18th February, 1908, at half-past Eight o'clock P.M., when the following communications will be made:—

1. R. STAPLES-BROWNE, M.A., F.Z.S.—On the Inheritance of Colour in Domestic Pigeons, with Special Reference to Reversion.

2. OLDFIELD THOMAS, F.R.S., F.Z.S.—The Duke of Bedford's Zoological Exploration in Eastern Asia.—IX. List of Mammals from the Mongolian Plateau.

3. G. T. BETHUNE-BAKER, F.L.S., F.Z.S.—Descriptions of new Species of Rhopalocera from Africa and from New Guinea.

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Communications intended for the Scientific Meetings of the ZOOLOGICAL SOCIETY OF LONDON should be addressed to

P. CHALMERS MITCHELL,  
*Secretary.*

3 HANOVER SQUARE, LONDON, W.  
*February 11th, 1908.*

ABSTRACT OF THE PROCEEDINGS  
OF THE  
ZOOLOGICAL SOCIETY OF LONDON.\*

February 18th, 1908.

Dr. HENRY WOODWARD, F.R.S., Vice-President,  
in the Chair.

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The SECRETARY read a report on the additions that had been made to the Society's Menagerie during the month of January 1908.

Mr. R. I. Pocock, Superintendent of the Gardens, exhibited, on behalf of Mr. W. SIMPSON CROSS, F.Z.S., a photograph taken from a living specimen of a very rare South-American Dog (*Canis jubatus*), sometimes called the Maned Wolf.

Mr. R. H. BURNE, F.Z.S., exhibited and remarked upon a number of preparations of the olfactory organs of Birds and Fishes.

Dr. L. W. SAMBON, F.Z.S., exhibited a large series of specimens of internal parasites obtained by him from animals recently living in the Society's Gardens. He laid stress on the important additions to knowledge to be derived from an adequate investigation of such material, and on the practical results to the health of the animals in the Gardens that might be expected.

Mr. R. STAPLES-BROWNE, F.Z.S., read a paper "On the Inheritance of Colour in Domestic Pigeons, with Special Reference

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to Reversion," and exhibited a series of skins illustrating some experiments on which his communication was based. Crosses had been made between black Barbs and white Fantails. The F. 1 generation was black with some white feathers. In the F. 2 generation, among other forms, blacks and whites were obtained, and also some blues. Blues were found to be dominant to whites, but blacks were dominant, or rather "epistatic," to the blues, which accounts for the fact that the reversionary form does not appear until the F. 2 generation. When two blues of the F. 2 or later generations were mated together blacks were never obtained again. A white in F. 2 mated to a Fantail gave whites only.

A second series of skins illustrated a cross between a white Tumbler and a white Fantail. Some white birds splashed with red had figured in the ancestry of the Tumbler, although the bird itself showed no trace of colour. In the F. 1 generation such splashed kinds occurred, which, when mated together, gave in F. 2 birds which were red and white with some distinct blue feathers. Possibly the white Tumbler was a dominant white.

MR. OLDFIELD THOMAS, F.R.S., F.Z.S., read a paper on mammals collected by Mr. M. P. Anderson during a trip to the Mongolian Plateau, N.W. of Kalgan. Nine species were mentioned, of which two were described as new.

The paper formed the eighth of the series on the results obtained by the Duke of Bedford's Zoological Exploration in Eastern Asia.

No properly collected material from the Mongolian plateau had been previously available to students, and these specimens, representatives of its comparatively poor fauna, were therefore of much interest.

A communication was received from Mr. G. T. BETHUNE-BAKER, F.L.S., F.Z.S., in which the author described as new to science a number of species of Butterflies of the division Rhopalocera, from Africa and from New Guinea.

The next Meeting of the Society for Scientific Business will be held on Tuesday, the 3rd March, 1908, at half-past Eight o'clock P.M., when the following communications will be made:—

1. F. E. BEDDARD, M.A., F.R.S., Prosector to the Society.—A Comparison of the Neotropical Species of *Corallus*, *C. cookii* with *C. madagascariensis*; and on some Points in the Anatomy of *Corallus caninus*.

2. P. CHALMERS MITCHELL, M.A., D.Sc., LL.D., F.R.S., Secretary to the Society.—On a Young Female Kordofan Giraffe.

3. R. I. Pocock, F.L.S., Superintendent of the Gardens.—Description of a new Species of Monkey of the Genus *Cerco-pithecus*.

---

The following communications have been received :—

1. Dr. KNUD ANDERSEN.—A Monograph of the Chiropteran Genera *Uroderma*, *Enchisthenes*, and *Artibeus*.

2. WALTER A. KIDD, Esq., M.D., M.R.C.S., F.Z.S.—Some Observations on the Effects of Pressure upon the Direction of Hair in Mammals.

---

Communications intended for the Scientific Meetings of the ZOOLOGICAL SOCIETY OF LONDON should be addressed to

P. CHALMERS MITCHELL,

*Secretary.*

3 HANOVER SQUARE, LONDON, W.

*February 25th, 1908.*



ABSTRACT OF THE PROCEEDINGS  
OF THE  
ZOOLOGICAL SOCIETY OF LONDON.\*

March 3rd, 1908.

G. A. BOULENGER, Esq., F.R.S., Vice-President, in the Chair.

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The SECRETARY read a letter from Mr. Roland Trimen, F.R.S., F.L.S., F.Z.S., in which he described the presence of a cuticular claw-like growth, about seven lines in length, on the tip of the tail of a domestic cat in his possession. The Secretary exhibited, for comparison, the tail of a young lion on which such a structure is well known to occur.

The SECRETARY exhibited some skins of the Coypu (*Myocastor coypu*) lent to him for the purpose by Mr. C. Hawkins, and called attention to the dorso-lateral position of the nipples of the mammary glands. The peculiar position of these organs in the Coypu and some of its allies had long ago been discussed by Sir Richard Owen, but apparently was not known to writers of recent textbooks.

Mr. F. E. BEDDARD, M.A., F.R.S., Prosector to the Society, exhibited a preparation of the colon and rectum of the Badger (*Meles meles*), and directed attention to the unusual size of the Payer's patches.

Dr. P. CHALMERS MITCHELL, M.A., F.R.S., Secretary to the Society, read a paper entitled "On a Young Female Kordofan Giraffe," and illustrated his remarks by lantern-slides. He compared the coloration of this specimen, born at the Gardens, with that of its parents and with that of a young female Giraffe from Nigeria, now living in the Society's Collection, and stated that

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the evidence to be derived from the study of this specimen strengthened the case for the distinctness of the Giraffes from Kordofan and Nigeria.

Mr. F. E. BEDDARD, M.A., F.R.S., Prosector to the Society, gave an account of his communication entitled "A Comparison of the Neotropical Species of *Corallus*, *C. cookii* with *C. madagascariensis*; and on some Points in the Anatomy of *Corallus caninus*."

Mr. R. I. Pocock, F.L.S., Superintendent of the Gardens, gave a description of a new species of Monkey of the genus *Cercopithecus*, which differs from *C. neglectus* principally in the absence of the black band across the head, in the reddish tinge of the hairs beneath the callosities, and in the similarity in colouring between the tail and the body. He proposed to name this new Monkey *Cercopithecus ezrae*.

The next Meeting of the Society for Scientific Business will be held on Tuesday, the 17th March, 1908, at half-past Eight o'clock P.M., when the following communications will be made:—

1. WALTER A. KIDD, M.D., M.R.C.S., F.Z.S.—Some Observations on the Effects of Pressure upon the Direction of Hair in Mammals.

2. O. THOMAS, F.R.S., F.Z.S., and R. C. WROUGHTON, F.Z.S.—The Rudd Exploration of S. Africa.—IX. List of Mammals obtained by Mr. Grant on the Gorongoza Mountains, Portuguese S.E. Africa.

3. R. I. Pocock, F.L.S., Superintendent of the Gardens.—Notes upon some Species and Geographical Races of Serows (*Capricornis*) and Gorals (*Nemorhedus*) based upon Specimens exhibited in the Society's Gardens.

The following communication has been received:—

Dr. KNUD ANDERSEN.—A Monograph of the Chiropteran Genera *Uroderma*, *Enchisthenes*, and *Artibeus*.

Communications intended for the Scientific Meetings of the ZOOLOGICAL SOCIETY OF LONDON should be addressed to

P. CHALMERS MITCHELL,

*Secretary.*

3 HANOVER SQUARE, LONDON, W.

March 10th, 1908

ABSTRACT OF THE PROCEEDINGS  
OF THE  
ZOOLOGICAL SOCIETY OF LONDON.\*

March 17th, 1908.

Dr. HENRY WOODWARD, F.R.S., Vice-President,  
in the Chair.

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The SECRETARY read a Report on the additions that had been made to the Society's Menagerie during the month of February 1908.

Mr. G. A. BOULENGER, F.R.S., V.P.Z.S., exhibited a remarkably malformed Plaice (*Pleuronectes platessa*) from the London market, which had been given him by the Secretary of the Fishmongers' Company. One of the most striking peculiarities of the specimen was that the colouring and scaling of the two sides of the tail were exactly alike and similar to the normal condition of the coloured side. Mr. Boulenger suggested that the tail might be a regeneration in which an ancestral condition had reappeared.

Dr. WALTER KIDD, F.Z.S., F.R.S.E., read a paper on "Some Observations on the Effects of Pressure upon the Direction of Hair in Mammals." This paper was a sequel to other communications on the subject of the direction of hair, and consisted chiefly of the observed effects of the pressure of harness on certain regions of the coats of domestic horses. This pressure was shown to produce reversed areas of hair, and it was held that these results supported the view put forward in other papers that changes in the arrangement of hair are due to mechanical

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\* This Abstract is published by the Society at 3 Hanover Square, London, W., on the Tuesday following the date of Meeting to which it refers. It will be issued, free of extra charge, to all Fellows who subscribe to the Publications, along with the 'Proceedings'; but it may be obtained on the day of publication at the price of *Sixpence*, or, if desired, sent post-free for the sum of *Six Shillings* per annum, payable in advance.



causes. Fifty-three cases were brought together and eight different regions of the coats of the Horse were shown in which the effects of pressure were found.

A paper was read by Messrs. OLDFIELD THOMAS, F.R.S., F.Z.S., and R. C. WROUGHTON, F.Z.S., on "Mammals obtained by Mr. C. H. B. Grant in the Gorongoza Mountains, Portuguese S.E. Africa," being the ninth of the series of papers on the Mammals of the Rudd Exploration of South Africa. 150 specimens were dealt with, belonging to 31 species and subspecies, of which three were described as new.

Mr. R. I. Pocock, F.L.S., the Superintendent of the Gardens read a paper entitled "Notes upon some Species and Geographical Races of Serows (*Capricornis*) and Gorals (*Nemorhedus*), based upon Specimens exhibited in the Society's Gardens," and pointed out that the "grey" Goral of the Himalayas was originally described by Hardwicke as *Antelope goral*, and that the "brown" Goral, to which the specific title *goral* has been applied in recent literature, required a new name. He proposed to call it *Nemorhedus hodgsoni*. Concerning the genus *Capricornis*, he stated that although only one form had been hitherto distinguished from the Himalayas, the available material pointed to the existence of at least four subspecies in that mountain-range. The following were characterized as new:—*Capricornis sumatraensis humei*, with a rufous-brown head, from Kashmir; *C. s. rodoni*, with a white interramal area and throat-patch, white underside and lower legs, and a long thick coat with underfur, from Chamba; *C. s. jamrachi*, with short black coat, blackish-brown underside, and partially rufous lower legs, from Darjiling. A black form from Selangor, with a scarcely appreciable quantity of red in the main, was also described as new under the name *C. s. robinsoni*.

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The next Meeting of the Society for Scientific Business will be held on Tuesday, the 7th April, 1908, at half-past Eight o'clock P.M., when the following communications will be made:—

1. Dr. KNUD ANDERSEN.—A Monograph of the Chiropteran Genera *Uroderma*, *Euchisthenes*, and *Artibeus*.
2. Sir RAY LANKESTER, K.C.B., F.R.S., F.Z.S.—On certain Points in the Structure of the Cervical Vertebrae of the Okapi and the Giraffe.

3. H. R. Hogg, M.A., F.L.S., F.Z.S.—Some Australian Spiders.

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The following communication has been received:—

Mrs. E. W. SEXTON.—On the Amphipod Genus *Trischizostoma*.

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Communications intended for the Scientific Meetings of the ZOOLOGICAL SOCIETY OF LONDON should be addressed to

P. CHALMERS MITCHELL,

*Secretary.*

3 HANOVER SQUARE, LONDON, W.

*March 24th, 1908.*



ABSTRACT OF THE PROCEEDINGS  
OF THE  
ZOOLOGICAL SOCIETY OF LONDON.\*

April 7th, 1908.

Dr. HENRY WOODWARD, F.R.S., Vice-President,  
in the Chair.

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On behalf of Mr. THOMAS CODRINGTON, Dr. A. SMITH WOODWARD, F.R.S., F.Z.S., exhibited a collection of 168 stones, weighing altogether 7 lbs. 13 oz., taken from the stomach of an Elephant shot by Mr. H. Thornicroft in Northern Rhodesia. The animal was a large male, with tusks weighing 45 lbs. each. The stones showed no signs of attrition.

Dr. C. W. ANDREWS, F.R.S., F.Z.S., exhibited a restored model of the skull and mandible of *Prozeuglodon atrox* And. This animal is one of the links uniting the true Zeuglodonts with the land Creodonts. It is found in the Middle Eocene of Egypt, where also the earlier type, *Protocetus*, was discovered by Fraas at a somewhat lower horizon. The model was constructed by Mr. F. O. Barlow, for the British Museum of Natural History.

The SECRETARY exhibited a photograph of two young living examples of the Forest-Pig of Central Africa (*Hylochoerus meinertzhageni* Thomas). The photograph had been taken by Mr. T. J. Morson, of Limoru, who had obtained the pigs in the Limoru and escarpment forest about 353 miles from Mombasa, at an elevation of between seven and eight thousand feet.

The SECRETARY stated that he had been informed by the High

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Commissioner for New Zealand, that the Chamois presented by the Emperor of Austria to New Zealand, and which had been successfully taken to New Zealand by one of the Society's staff in the beginning of 1907, had been seen in the locality in which they were liberated, one of the females being accompanied by a strong, healthy-looking kid.

The SECRETARY presented, on behalf of Dr. KNUD ANDERSEN, a communication entitled "A Monograph of the Chiropteran Genera *Uroderma*, *Enchisthenes*, and *Artibeus*." The work was based on an examination of the material in the British and United States National Museums, and contained a discussion of the homologies of the teeth and molar cusps in Stenodermatous Bats, a full description of the genera mentioned in the title, their species and subspecies, with a discussion of their probable inter-relations, and finally remarks on the bearing of the present geographical distribution of the species and sub-species on a former connection of the West Indian Islands with continental America.

The SECRETARY read a communication from Sir E. RAY LANKESTER, K.C.B., F.R.S., F.Z.S., entitled "On certain Points in the Structure of the Cervical Vertebrae of the Okapi and Giraffe." The paper dealt chiefly with the posterior cervical and anterior dorsal vertebrae, the Author concluding that where the Okapi differed in these respects from the Giraffe, it resembled other and particularly bovine Artiodactyles. It also included a discussion of the zygapophysial articulations of the cervical and dorsal vertebrae in the Giraffe, Okapi, and some other Mammals.

Mr. H. R. HOGG, M.A., F.Z.S., gave an account of a paper on "Some Australian Spiders," in which he gave further notes on the type species of the genus *Missulena*, hitherto known only by two specimens, a synopsis of the New Zealand genus *Hexathele*, with description of two new species, and a description of two new species of *Dolomodes* Latreille, from Pitt Island of the Chatham Group, showing affinities with the only two species recorded from New Zealand.

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The next Meeting of the Society for Scientific Business will be held on Tuesday, the 28th April, 1908, at half-past Eight o'clock P.M., when the following communications will be made:—

1. Mrs. E. W. SEXTON.—On the Amphipod Genus *Trischizostoma*.

2. C. L. BOULENGER, B.A., F.Z.S.—On the Breeding-Habits of a Cichlid Fish (*Tilapia nilotica*).

3. C. TATE REGAN, M.A., F.Z.S.—A Revision of the Sharks of the Family *Orectolobidae*.

4. G. A. BOULENGER, F.R.S., V.P.Z.S.—A Revision of the Oriental Pelobatid Batrachians (Genus *Megalophrys*).

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The following communications have been received :—

1. C. F. JENKIN.—The C. Crossland Collection of Calcarea from Zanzibar and Wasin (British East Africa).

2. R. E. TURNER, F.Z.S.—Notes on the Australian Fossorial Wasps of the Family *Sphagilæ*, with Descriptions of new Species.

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P. CHALMERS MITCHELL,

*Secretary.*

3 HANOVER SQUARE, LONDON, W.

*April 14th, 1908.*



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